ISSN 0193-2853

Herbicide Influence on Foliar Amino Acid Content in Five Representative Southwestern Range-Plant Species

U.S. Department of Agriculture
Agricultural Research Service
Agricultural Research Results • ARR-S-13/December 1982

Herbicide Influence on Foliar Amino Acid Content in Five Representative Southwestern Range-Plant Species

By R. E. Meyer, H. E. Smalley
J. F. Cooper, and F. M. Farr

U.S. Department of Agriculture
Agricultural Research Service
Agricultural Research Results • ARR-S-13/December 1982

THE AUTHORS

R. E. Meyer is a plant physiologist with the Grassland Protection Research Unit, Agricultural Research Service, U.S. Department of Agriculture, Department of Range Science, Texas A&M University, College Station, Tex. 77843.

H. E. Smalley was the director, now retired, and J. F. Cooper and F. M. Farr are biological laboratory technicians at the Veterinary Toxicology and Entomology Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, P.O. Drawer GE, College Station, Tex. 77841.

The research reported in this publication was done in cooperation with the Texas Agricultural Experiment Station.

This publication is available from the Grassland Protection Research Unit, Agricultural Research Service, Department of Range Science, Texas A&M University, College Station, Tex. 77843.

Agricultural Research Service, Agricultural Research Results, Southern Series, No. 13, December 1982.

Published by Agricultural Research Service (Southern Region), U.S. Department of Agriculture, P.O. Box 53326, New Orleans, La. 70153.

CONTENTS

TABLES

ABSTRACT

Herbicides had varied effects on amino acid and ammonia concentrations in foliage of roundseed dicanthelium, *Dicanthelium sphaerocarpon* (Ell.) Gould, and western ragweed, *Ambrosia psilostachya* DC., and in leaves of honey mesquite, *Prosopis juliflora* (Swartz) DC. var. *glandulosa* (Torr.) Cockerell; yaupon, *Ilex vomitoria* Ait.; and Macartney rose, *Rosa bracteata* Wendl. Herbicides used were atrazine, bromacil, 2,4-D, dalapon, dicamba, 3-6-dichloropicolinic acid (3,6-DPA), glyphosate, hexazinone, picloram, 2,4,5-T, tebuthiuron, and triclopyr. Plant samples were taken on four dates after spraying, processed, and analyzed for individual amino acids and ammonia and for total amino acids plus ammonia. Percentage of plant injury was also determined for each species. Generally, herbicides producing the most rapid development of foliar injury caused the most changes in amino acid concentrations. Index terms: *Ambrosia psilostachya*, amino acid concentrations, ammonia concentrations, atrazine, bromacil, 2,4-D, dalapon, dicamba, *Dicanthelium sphaerocarpon*, 3,6-dichloropicolinic acid, glyphosate, herbicides, hexazinone, honey mesquite, *Ilex vomitoria*, Macartney rose, picloram, plant nutrition, *Prosopis juliflora* var. *glandulosa*, range plants, *Rosa bracteata*, roundseed dicanthelium, 2,4,5-T, tebuthiuron, triclopyr, weeds, western ragweed, yaupon.

Address communications to: R. E. Meyer, Agricultural Research Service, Department of Range Science, Texas A&M University, College Station, Tex. 77843.

INTRODUCTION

Several herbicides are known to benefit some plants in various ways when applied at sublethal levels. These herbicides will increase content of various amino acids, total crude protein, and other plant biochemical components and will improve growth and yield (see, for example, Ries et al. 1963, 1967, 1968; Ries and Gast 1965; Fink and Fletchall 1967; Pulver and Tweedy 1968; Baur et al. 1970, 1977; Arnold and Nalewaja 1971; Kay et al. 1971; Tweedy et al. 1971; Hiranpradit et al. 1972; Singh et al. 1972; Steenbjerg et al. 1972; Houston and van der Sluijs 1973; and Jung and Blohm 1974). Many of these sometimes beneficial herbicides are used in the Southwestern United States for either general or specific weed control (see, for example, Meyer et al. 1969, 1970, 1978; Scifres and Hoffman 1972; Elwell and McMurphy 1973; Texas Agricultural Experiment Station 1973; Scifres 1975; Byrd and Colby 1978; Meyer and Baur 1979; Jacoby et al. 1980; and Meyer and Bovey 1980a, 1980b, 1980c). Of course, these herbicides vary in their effectiveness at controlling different species. And we knew that the beneficial effects would probably vary also, so we undertook this study to find out how various herbicides influence amino acid composition of five typical range plants (the leaves of three woody species and the aboveground parts of the other two). These plants were a grass, roundseed dicanthelium, *Dicanthelium sphaerocarpon* (Ell.) Gould; a broadleaf herbaceous species, western ragweed, *Ambrosia psilostachya* DC.; and three woody species. These were honey mesquite, *Prosopis juliflora* (Swartz) DC. var. *glandulosa* (Torr.) Cockerell; yaupon, *Ilex vomitoria* Ait.; and Macartney rose, *Rosa bracteata* Wendl. Knowing how various herbicides affect amino acid content of these plants should be useful to ranchers and wildlife managers, who need to know the nutritive value of livestock and wildlife feed. And weed scientists should find the information equally valuable; knowing how herbicides affect plant biochemistry should help them develop more effective herbicides.

MATERIALS AND METHODS

The amino acid changes of all five species were studied in the Claypan Resource Area of Texas in Brazos County near College Station. At time of spraying, the two herbaceous species, roundseed dicanthelium and western ragweed, were 10 to 25 cm tall and were growing on a Falba loam (a member of the fine, montmorillonitic, thermic Typic Albaqualfs). Honey mesquite plants, which had been mowed about 1 year earlier, were 1 to 1.5 m tall and were growing on a Burleson clay (a member of the fine, montmorillonitic, thermic Udic Pellusterts). Yaupon plants were 1 to 1.5 m tall and were growing on a Padina loamy find sand (a member of the loamy, siliceous, thermic Grossarenic Paleustalfs). The Macartney rose plants were 1 to 2 m tall and were growing on a Ferris clay (a member of the fine, montmorillonitic, thermic Udorthentic Chromusterts).

Plots for the herbaceous species were 6.1 by 18.3 m. Treatments were replicated three times. Plots for honey mesquite were 6.1 by 18.3 m; those for the other two woody species were 10.7 by 18.3 m. Two replicates were used for the three woody species. All plots were established in a randomized complete-block design.

Herbicides for roundseed dicanthelium, western ragweed, yaupon, and Macartney rose were applied broadcast in water at 187 liters/ha with a tractor-mounted boom sprayer. A hand-carried, compressed-air-operated boom sprayer dispensing the same liquid volume was used to spray the honey mesquite. Herbicides applied included 80%

ai (active ingredient) wettable-powder formulations of atrazine (see appendix for chemical names of herbicides) and tebuthiuron, emulsifiable bromacil, 74% ae (acid equivalent) magnesium-sodium salt of dalapon, dimethylamine salt of dicamba, propylene glycol butyl ether esters of 2,4-D and 2,4,5-T, isopropylamine salt of glyphosate, 90% ai crystalline hexazinone, monoethanolamine salt of 3-6-dichloropicolinic acid (3,6-DPA), potassium salt of picloram, and ethylene glycol butyl ether esters of triclopyr. All herbicides were applied on the herbaceous species except 3,6-DPA; all herbicides were applied at 1.12 kg/ha except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha). Four or five herbicides were applied on the woody species, at 1.12 kg/ha on honey mesquite and 2.24 kg/ha on Macartney rose and yaupon.

Plant samples were collected for each species at four dates between the date of spraying and a maximum of 27 days after application. The interval depended to some extent on the species. About 100 g of plant material was put in plastic bags and placed on ice until brought to the laboratory. Then the samples were frozen until chemically analyzed. For each replicate sample of roundseed dicanthelium and western ragweed, 10 plants were cut off about 2 cm above the ground in each plot. And for honey mesquite, yaupon, and Macartney rose, about 200 mature dark-green leaves were collected at random from 5 to 10 plants in each plot.

Before amino acid analysis, plant parts were rated for herbicide injury or discoloration and then were cut into 2.5-cm sections, lyophilized, and ground to pass an 8-mesh/cm screen. A 0.2-g sample was hydrolyzed with 100 ml of 6 *N* HCl for 24 hours in a nitrogen atmosphere. The hydrolysates were evaporated to dryness and rinsed with de-ionized water until free of HCl. The samples were dried again. The hydrolysates were diluted with sodium acetate buffer with a pH of 2.2 so that 1 ml contained about 0.4 mg of protein. The samples were then filtered and 0.50 ml placed on the resin column of a Beckman model 120C amino acid analyzer.

Tracings made with amino acids of known concentrations were used as standards to convert tracings of the samples to grams of amino acid per 100 g of moisture-free tissue. Since the amount of ammonia was included in the analysis, it was combined for data analysis with total amino acids.

The data on each amino acid, total amino acids with ammonia, and percentage of plant injury were analyzed in two ways. First, they were analyzed as a factorial design, with herbicides and time after treatment as the main effects. Second, results of each herbicide treatment at each date of sampling were analyzed as a randomized complete-block design. Means were compared by Duncan's new multiple-range test at the 5% level.

RESULTS AND DISCUSSION

Amino Acids in Untreated Plants

Concentrations of amino acids and ammonia varied widely among species (table 1). The highest concentration (16.88 g/100 g tissue) occurred in honey mesquite leaves. Western ragweed foliage and Macartney rose leaves had intermediate concentrations (9.64 and 9.87 g/100 g tissue), and roundseed dicanthelium foliage and yaupon leaves contained the lowest (7.5 and 7.72 g/100 g tissue). The reason for the wide variation is not clear. The textures of the roundseed dicanthelium foliage and honey mesquite leaves are similar, but amino acids were about twice as concentrated in honey mesquite. Likewise, thick, waxy leaves of yaupon had lower amino acid concentrations than similar leaves of Macartney rose. The percentages of the various amino acids in the total were similar among all five species.

Amino acid concentrations decreased progressively in succeeding samplings of roundseed dicanthelium (table 1), while those in western ragweed were slightly higher at the second (7-day) sampling than at 27 days. Apparently, the reductions occurred because of increases in structural carbohydrates. Leaves of honey mesquite, yaupon, and Macartney rose were mature at the first sampling (2-day), so amino acid content did not change during the overall sampling period.

Although the concentration of amino acids varied, their ranks were similar among all five species (table 2). The two dicarboxylic amino acids, aspartic acid and glutamic acid, occurred in the highest concentrations. Leucine ranked third. Alanine, lysine, arginine, and valine generally grouped from 4th through 7th; proline, glycine, and phenylalanine from 8th through 10th; serine and threonine, the two amino acids with hydroxyl groups, and isoleucine from 11th through 13th; and tyrosine, histidine, methionine, and ammonia from 14th through 17th.

Similarly, Chibnall et al. (1963) found that most nitrogen in nine species, including ryegrass, occurs in arginine, glutamic acid, and lysine. In alfalfa, Wilson and Tilley (1965) found that arginine occurs in the highest concentration, followed by lysine. And Bandemer and Evans (1963) studied the amino acid concentration of seeds of nine species and found that glutamic acid occurs in the highest concentration in rice (*Oryza sativa* L.) and wheat and that leucine occurs second highest in concentration for corn (*Zea mays* L.) and sudangrass (*Sorghum sudanense* (Piper) Stapf.), while aspartic acid is second most abundant in rice, bean (*Phaseolus vulgaris* L.), and sunflower. Glutamic acid and arginine occur in the highest concentration in cottonseed (Lefler et al. 1977, Elmore et al. 1979, Elmore and Paul 1980). Glutamic acid and aspartic acid occur in the highest concentrations in cotton leaves (McMichael and Elmore 1977). Glutamic acid occurs in the highest concentration in the nutmeats of pecan, *Carya illinoensis* (Wangenh.) K. Koch (Elmore and Polles 1980).

Herbicide Effects on the Five Species

Herbicides had various visible effects on the five species (tables 3–7). None caused visible injury 2 days after treatment. Roundseed dicanthelium and western ragweed were sprayed with herbicides April 26, 1978, and rated 2, 7, 14, and 27 days later. On roundseed dicanthelium (table 4) 7 days after treatment, dalapon and glyphosate, the two foliar-active herbicides most active on grasses, caused significant injury (70% and 67%) compared to the untreated plants (7%). After 14 and 27 days, bromacil, dalapon, glyphosate, and hexazinone caused 80%–100% leaf and stem injury. By 27 days, the untreated plants showed some injury (30%) because of the dry weather.

On western ragweed, none of the herbicides caused significant leaf or stem chlorosis or necrosis after 2 or 7 days (table 5). But, after 14 days, atrazine, 2,4-D, dalapon, hexazinone, picloram, and tebuthiuron caused 47%–70% injury. After 27 days, all herbicides caused significant injury, and five killed all the plants.

None of the herbicides caused significant visible injury to honey mesquite leaves 4 days after spraying (table 6). All herbicides except 2,4,5-T, however, caused significant injury after 6 days. All herbicides caused significant injury after 10 days, but only 3,6-DPA and picloram had killed all the leaves. Leaves killed by 3,6-DPA and picloram turned brown and generally remained on the plants at the end of 10 days. The other herbicides yellowed the leaflets, and some leaflets abscised by the end of 10 days.

On yaupon, no injury was observed on leaves or stems of untreated plants or plants sprayed with 3,6-DPA through 21 days (table 3; note—data for yaupon were combined because no date or date-by-treatment interactions were significant). Picloram, 2,4,5-T, and triclopyr caused 2%–10% and 35%–50% injury after 5 and 14 days. After 21 days, picloram caused 65% injury, 2,4,5-T 82%, and triclopyr 85%. The injured leaves developed black spots that generally spread until the whole leaf was black.

On Macartney rose, no herbicide treatment caused significant leaf or stem chlorosis or necrosis after 4 days (table 7). But, 8 days after treatment, 2,4-D, picloram, and triclopyr caused 75%–95% injury, and 2,4-D and picloram killed all the leaves, turning them brown to black at 18 days. The 3,6-DPA and glyphosate treatments were ineffective, having caused no significant injury through 18 days. The date-by-treatment interaction was significant.

So, visible foliar injury was generally first expressed by plants treated with the herbicides most effective at control: dalapon and glyphosate for roundseed dicanthelium; 2,4-D, picloram, and tebuthiuron for western ragweed; 3,6-DPA and picloram for honey mesquite; picloram and 2,4,5-T for yaupon; and 2,4-D and picloram for Macartney rose. The clear-cut selectivity of 3,6-DPA was demonstrated by its effectiveness on honey mesquite and ineffectiveness on yaupon and Macartney rose.

Herbicide Effects on Concentrations of Total Amino Acids and Ammonia

Amino acid concentrations varied because of herbicide effects, except in yaupon, and in some cases because of plant aging. As shown in table 1, the total amino acid concentration tended to decrease with time in the two herbaceous species, but the concentration remained essentially constant in the three woody plants. Tables 8–11 list concentrations of total amino acids and ammonia by date and treatment for each species except yaupon, where only the mean data for all dates are presented.

No herbicide significantly affected concentration of total amino acids in ammonia in roundseed dicanthelium after 2 days (table 8). After 7 days, the amino acid content was higher in plants treated with atrazine, bromacil, and tebuthiuron than in untreated plants. After 14 days, atrazine, hexazinone, picloram, and tebuthiuron increased amino acid concentration over that of untreated plants. After 27 days, atrazine, bromacil, 2,4-D, dicamba, 2,4,5-T, tebuthiuron, and triclopyr all increased amino acid content over that of untreated plants at the same date.

For western ragweed, differences were significant among dates and herbicides (table 9). But no differences occurred 2 days after treatment. Atrazine increased amino acid concentration 7 days after treatment, and glyphosate reduced it 14 days after treatment. Averaged over all dates, atrazine increased amino acid content; 2,4-D, dicamba, glyphosate, and triclopyr reduced it.

In honey mesquite 2 days after treatment, no herbicide affected total amino acids including ammonia (table 10). Picloram and triclopyr reduced amino acid concentration 4 days after treatment, and all herbicides reduced amino acid concentration 6 and 10 days after treatment.

In yaupon (table 3), amino acid plus ammonia concentration did not vary among dates (2, 5, 14, and 21 days), nor was the date-by-herbicide interaction significant. So, only the main effects for herbicides are given. These show that picloram, 2,4,5-T, and triclopyr reduced the amino acid concentration equally, while 3,6-DPA had no effect.

In Macartney rose (table 11), 2 days after treatment, 3,6-DPA increased total amino acid content, and triclopyr reduced it. This was the only species where total amino acid content was affected 2 days after treatment. Picloram and triclopyr reduced amino acid concentration at 4, 8, and 18 days, and 2,4-D reduced it 8 and 18 days after treatment.

Herbicide Effects on Individual Amino Acids

Tables 3 and 12–15 show which amino acids increased or decreased (compared to untreated plants) in each species at each of the four sampling dates after treatment. Tables 16–83 give the results for each amino acid with date-by-treatment interactions for each species except yaupon.

Effects by plant species

Few changes occurred in roundseed dicanthelium (tables 12 and 16–32) within 2 days after treatment. Dicamba decreased methionine (table 26), and tebuthiuron increased alanine (table 16) and valine (table 32). Herbicides had various effects on amino acid concentrations in roundseed dicanthelium at 7, 14, and 27 days after treatment (table 12). Atrazine caused 10 or more amino acids to increase in concentration during this period. Dalapon and glyphosate, two rapid-acting herbicides effective for controlling grasses, decreased concentrations of several amino acids 7 and 14 days after treatment. Bromacil, 2,4-D, dicamba, picloram, 2,4,5-T, tebuthiuron, and triclopyr increased amino acid concentration, primarily 27 days after treatment. Aspartic acid (table 19) and glutamic acid (table 20), the two dicarboxylic acids, were the amino acids most often increasing after herbicide application.

In western ragweed (tables 13 and 33–49) at 2 days after treatment, 2,4-D reduced aspartic acid (table 36), and dalapon increased proline (table 45) concentration. Atrazine caused a temporary increase in 13 amino acids and ammonia 7 days after treatment. Bromacil, hexazinone, and tebuthiuron increased aspartic acid (table 36) 7 and 14 days after treatment. Herbicides effective for control of broadleaf plants such as western ragweed—2,4-D, dicamba, glyphosate, picloram, 2,4,5-T, and triclopyr—reduced the concentration of several amino acids.

In honey mesquite leaves (tables 14 and 50–66), main-effect differences among dates and herbicides were significant for all amino acids; only

ammonia was not significantly different by date. The date-by-treatment interactions were significant for all amino acids and ammonia. At 2 days after treatment (table 14), only 3,6-DPA increased arginine (table 52), and 2,4,5-T increased aspartic acid (table 53). Aspartic acid increased at 4 and 6 days after treatment with 3,6-DPA and at 6 days with picloram. At 4 days after treatment, glyphosate and 2,4,5-T had no effect on amino acids while 3,6-DPA reduced the tyrosine (table 65) concentration. Picloram reduced concentrations of 7 amino acids, and triclopyr reduced those of 13. The seven amino acids both herbicides reduced in concentration were alanine (table 50), glycine (table 55), lysine (table 59), methionine (table 60), phenylalanine (table 61), threonine (table 64), and tyrosine (table 65). At 6 and 10 days after treatment, all five herbicides reduced the concentration of 7–16 amino acids. Alanine (table 50), glycine (table 55), histidine (table 56), lysine (table 59), methionine (table 60), phenylalanine (table 61), and tyrosine (table 65) were reduced by all five herbicides at these two dates.

The 3,6-DPA did not affect concentration of individual amino acids in yaupon (table 3). None of the herbicides affected ammonia content. But 2,4,5-T and triclopyr reduced the concentration of almost all amino acids below that in untreated plants. Picloram reduced the concentration of about half the amino acids. These differences generally occurred at all sampling dates.

In Macartney rose (tables 15 and 67–83), glyphosate had little effect on amino acid concentration. The 3,6-DPA increased concentration of all amino acids and ammonia 2 days after spraying but then reduced the concentration of most of them 8 days after spraying even though the herbicide caused little visible injury to the foliage. The 2,4-D, picloram, and triclopyr all reduced amino acid concentrations—triclopyr at all dates beginning at 2 days after treatment and 2,4-D and picloram mainly beginning 4 days after treatment.

Effects by herbicide

Atrazine markedly increased concentration of all amino acids in roundseed dicanthelium and western ragweed, the two species treated with it; however, in a few instances, the differences were not significant. The largest increase was in aspartic acid (tables 19 and 36) concentration. These increases by triazine herbicides have been found by others (see, for example, Fink and Fletchall 1967, Kay 1971, Tweedy et al. 1971, and Houston and van der Sluijs 1973). Ashton and Crafts (1973) indicate that subtoxic amounts of triazine herbicides increase levels of nitrogen in plants. These increases are most likely to occur at low levels of nitrogen and under adverse climatic conditions; both conditions probably occurred in this study. Apparently, triazine herbicides increase nitrate reductase activity, therefore enabling plants to use nitrate more efficiently than they use ammonia. Since plant weights were not recorded, it was not possible to determine if increased amino acid concentrations were accompanied by decreases in plant weight.

In most cases, 2,4-D had little effect on amino acids in the tolerant roundseed dicanthelium (table 12). But it generally reduced concentrations of most amino acids in the broadleaf species, western ragweed (table 13) and Macartney rose (table 15). Probably, 2,4-D and other phenoxy herbicides inhibited protein synthesis in the susceptible species at the rate applied. But, at certain lower rates, 2,4-D and 2,4,5-T have increased nucleic acid and protein content by enhancing DNA and RNA synthesis in several species (Bovey and Young 1980).

The 3,6-DPA is relatively specific for honey mesquite. It reduced all amino acid concentrations except aspartic acid and proline in honey mesquite (table 14). The 3,6-DPA did not affect amino acid concentration of the tolerant yaupon. But, in Macartney rose, it did increase amino acid concentration at 2 days and decrease it at 8 days after treatment. Dicamba slightly increased six amino acids in the resistent roundseed dicanthelium (table 12) but reduced concentration of most amino acids in the susceptible western ragweed (table 13).

Being an effective herbicide for controlling grasses, glyphosate reduced concentrations of most amino acids in roundseed dicanthelium (table 12), but it increased glutamic acid concentration. Glyphosate also reduced concentrations of 10 amino acids in western ragweed foliage and of all amino acids except proline in honey mesquite. Glyphosate has been postulated either to inhibit aromatic amino acid biosynthesis in plants (Jaworski 1972) or to reduce aromatic amino acid levels by increasing phenylalanine ammonia-lyase activity (Hoagland et al. 1978,

Duke et al. 1980). Our results support the postulate in that both tyrosine and phenylalanine concentrations were reduced at least on some species. Glyphosate has little effect on Macartney rose, possibly because the water-soluble herbicide cannot penetrate the waxy Macartney rose leaves to any extent.

Hexazinone, an effective herbicide for most grasses and some broadleaf species, increased aspartic acid, glycine, phenylalanine, and threonine in the grass, roundseed dicanthelium (table 12), and ammonia and aspartic acid in western ragweed through 14 days (table 13). But it reduced concentrations of six amino acids in western ragweed 27 days after treatment (table 13).

Picloram increased concentration of six amino acids in the resistent roundseed dicanthelium (table 12) but reduced concentration of most amino acids in honey mesquite (table 14) and Macartney rose (table 15). The 2,4,5-T increased 12 amino acid concentrations in roundseed dicanthelium (table 12) 27 days after treatment. It reduced concentrations of most amino acids in honey mesquite (table 14) and yaupon (table 3). Tebuthiuron increased the concentration of 12 amino acids in roundseed dicanthelium (table 12) and aspartic acid in western ragweed (table 13); the other amino acids were not affected. Triclopyr increased the concentration of 14 amino acids in roundseed dicanthelium (table 12), but reduced the concentration of most amino acids in yaupon (table 3), honey mesquite (table 14), and Macartney rose (table 15). Triclopyr caused the most common reduction in amino acids of any herbicide studied, but it was followed closely by picloram.

Since the precise mode of action of most of the herbicides is not known, it is difficult to determine the significance of the changes that have been recorded. In most cases, however, concentrations of amino acids decreased when the species was sprayed with a phytotoxic herbicide. Amino acid concentrations were generally not affected by herbicides in species resistant to the herbicide.

REFERENCES

Arnold, W. E., and Nalewaja, J. D.
1971. Effect of dicamba on RNA and protein. Weed Sci. 19: 301–305.

Ashton, F. M., and Crafts, A. S.
1973. Mode of action of herbicides. 504 pp. John Wiley, New York.

Bandemer, S. L., and Evans, R. J.
1963. The amino composition of some seeds. J. Agric. Food Chem. 11: 134–137.

Baur, J. R.; Bovey, R. W.; and Benedict, C. R.
1970. Effect of picloram on growth and protein levels in herbaceous plants. Agron. J. 62: 627–630.

Baur, J. R.; Bovey, R. W.; and Holt, E. C.
1977. Effect of herbicides on production and proteir levels in pasture grasses. Agron. J. 69: 846–851.

Bovey, R. W., and Young, A. L.
1980. The science of 2,4,5-T and associated phenoxy herbicides. 462 pp. John Wiley, New York.

Byrd, B. C., and Colby, R. W.
1978. Woody plant control with low volume applications of Garlon 3A herbicide. Down Earth 34(2): 7–11.

Chibnall, A. C.; Rees, M. W.; and Lugg, J. W.
1963. The amino-acid composition of leaf proteins. J. Sci. Food Agric. 14: 234–239.

Duke, S. O.; Hoagland, R. E.; and Elmore, C. D.
1980. Effects of glyphosate on metabolism of phenolic compounds. V. L-α-aminooxy-β-phenyl-propionic acid and glyphosate effects on phenylalanine ammonia-lyase in soybean seedlings. Plant Physiol. 65: 17–21.

Elmore, C. D., and Paul, R. N.
1980. Light and nitrogen affect storage protein mobilization in germinating cottonseed. Crop Sci. 20: 435–443.

Elmore, C. D., and Polles, S. G.
1980. Nitrogen fertilization effects on amino acid composition of pecan (*Carya illinoensis*) nutmeats. J. Agric. Food Chem. 28: 902–904.

Elmore, C. D.; Spurgeon, W. I.; and Thom, W. O.
1979. Nitrogen fertilization increases N and alters amino acid concentration of cottonseed. Agron. J. 71: 713–716.

Elwell, H. M., and McMurphy, W. E.
1973. Weed control with phenoxy herbicides on native grasslands. Okla. Agric. Exp. Stn. Bull. 706, 23 pp.

Fink, R. J., and Fletchall, O. H.
1967. The influence of atrazine and simazine on forage yield and nitrogen components of corn. Weeds 15: 272–274.

Hiranpradit, H.; Foy, C. L.; and Shear, G. M.
1972. Effects of low levels of atrazine on some mineral constituents and forms of nitrogen in *Zea mays* L. Agron. J. 64: 267–272.

Hoagland, R. E.; Duke, S. O.; and Elmore, D.
1978. Effects of glyphosate on metabolism of phenolic compounds. II. Influence on soluble hydroxyphenolic compound, free amino acid and soluble

protein levels in dark-grown maize roots. Plant Sci. Lett. 13: 291–299.

Houston, W. R., and van der Sluijs, D. H.
1973. Increasing crude protein content of forage with atrazine on shortgrass range. U.S. Dep. Agric. Prod. Res. Rep. 153, 10 pp.

Jacoby, P. W.; Meadors, C. H.; and Foster, M. A.
1980. Dowco 290 herbicide for control of honey mesquite. Tex. Agric. Exp. Stn. Rangeland Resour. Res. Consol. Prog. Rep. 2665, p. 26.

Jaworski, E. G.
1972. Mode of action of *N*-(phosphonomethyl)-glycine: inhibition of aromatic amino acid biosynthesis. J. Agric. Food Chem. 20: 1195–1198.

Jung, K., and Blohm, D.
1974. Zum Einfluss von 2-Methyl-4-chlor-phenoxyessigsäure auf die freien Aminosäuren von *Triticum vulgare*. Biol. Zentralbl. 93: 571–574.

Kay, B. L.
1971. Atrazine and simazine increase yield and quality of range forage. Weed Sci. 19: 370–372.

Lefler, H. R.; Elmore, C. D.; and Hesketh, J. D.
1977. Seasonal and fertility-related changes in cottonseed protein quantity and quality. Crop Sci. 17: 953–956.

McMichael, B. L., and Elmore, C. D.
1977. Proline accumulation in water stressed cotton leaves. Crop Sci. 17: 905–908.

Meyer, R. E., and Baur, J. R.
1979. Smutgrass (*Sporobolus poiretii*) control in pastures with herbicides. Weed Sci. 27: 361–366.

Meyer, R. E., and Bovey, R. W.
1980a. Control of live oak (*Quercus virginiana*) and understory vegetation with soil-applied herbicides. Weed Sci. 28: 51–58.
1980b. Control of whitebrush (*Aloysia lycioides*) and associated species with soil-applied herbicides. Weed Sci. 28: 204–212.
1980c. Hexazinone and other herbicides on Texas woody plants. Weed Sci. 28: 358–362.

Meyer, R. E.; Bovey, R. W.; and Baur, J. R.
1978. Control of an oak (*Quercus*) complex with herbicide granules. Weed Sci. 26: 444–453.

Meyer, R. E.; Morton, H. L.; Merkle, M. G.; Bovey, R. W.; and Davis, F. S.
1970. Brush control on forest-rangelands in east Texas. J. Range Manage. 23: 129–132.

Meyer, R. E.: Riley, T. E.; Morton, H. L.; and Merkle, M. G.
1969. Control of whitebrush and associated species with herbicides in Texas. Tex. Agric. Exp. Stn. Misc. Publ. 930, 18 pp.

Pulver, E. L., and Tweedy, J. A.
1968. Increases in nitrate and protein content of field grown corn treated with simazine and atrazine. Proc. Weed Sci. Soc. Am., 8th, p. 30. (Abstract.)

Ries, S. K.; Chimel, H.; Dilley, D. R.; and Filner, P.
1967. The increase in nitrate reductase activity and protein content of plants treated with simazine. Proc. Natl. Acad. Sci. U.S.A. 58: 526–532.

Ries, S. K., and Gast, A.
1965. The effect of simazine on nitrogenous components of corn. Weeds 13: 272–274.

Ries, S. K.; Larsen, R. P.; and Kentworthy, A. L.
1963. The apparent influence of simazine on nitrogen nutrition of peach and apple trees. Weeds 11: 270–273.

Ries, S. K.; Schweizer, C. J.; and Chimel, H.
1968. The increase in protein content and yield of simazine-treated crops in Michigan and Costa Rica. BioScience 18: 205–208.

Scifres, C. J.
1975. Fall application of herbicides improves Macartney rose-infested coastal prairie rangelands. J. Range Manage. 28: 483–486.

Scifres, C. J., and Hoffman, G. O.
1972. Comparative susceptibility of honey mesquite to dicamba and 2,4,5-T. J. Range Manage. 25: 143–146.

Singh, B.; Wu, M. T.; and Salunkhe, D. K.
1972. The use of chemicals to increase leaf and seed proteins of certain crops. Plant Foods Hum. Nutr. 2: 171–184.

Steenbjerg, F.; Larsen, I; Jensen, I.; and Bille, S.
1972. The effect of nitrogen and simazine on the dry-matter yield and amino acid content of oats and on the absorption and utilization of various plant nutrients. Plant Soil 36: 475–496.

Texas Agricultural Experiment Station.
1973. Suggestions for weed control with chemicals. Range and timber lands and pasture and forage crops. Tex. Agric. Exp. Stn. Misc. Publ. MP-1060, Part II, 14 pp.

Tweedy, J. A.; Kern, A. D.; and Kapusta, G.
1971. Yield and nitrogen content of wheat and sorghum treated with different rates of nitrogen fertilizers and herbicides. Agron. J. 63: 216–218.

Wilson, R. F., and Tilley, J. M.
1965. Amino-acid composition of lucerne and of lucerne and grass preparations. J. Sci. Food Agric. 16: 173–178.

Table 1.--Total amino acid concentrations in untreated plants at four intervals after treated plants were sprayed

Days after spraying[1]	Concentration (g/100 g moisture-free tissue) in--[2]				
	Roundseed dicanthelium	Western ragweed	Honey mesquite	Yaupon	Macartney rose
2	8.44a	10.14ab	16.90a	8.04a	10.41a
4-7	8.24a	10.63a	16.93a	7.88a	9.66a
6-14	7.23a	9.74ab	16.58a	7.78a	10.16a
10-27	6.08b	8.06b	17.10a	7.18a	9.27a
Mean	7.50	9.64	16.88	7.72	9.87

[1] Intervals after spraying when sampled: roundseed dicanthelium and western ragweed--2, 7, 14, and 21 days; honey mesquite--2, 4, 6, and 10 days; yaupon--2, 5, 14, and 21 days; Macartney rose--2, 4, 8, and 18 days.

[2] Values having a common letter are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 2.—Rank of means of amino acid and ammonia concentrations (highest to lowest) in untreated plants

Rank	Amino acid in--				
	Roundseed dicanthelium	Western ragweed	Honey mesquite	Yaupon	Macartney rose
1	Glutamic acid	Glutamic acid	Glutamic acid	Glutamic acid	Glutamic acid.
2	Aspartic acid	Aspartic acid	Aspartic acid	Aspartic acid	Aspartic acid.
3	Leucine	Leucine	Leucine	Leucine	Leucine.
4	Alanine	Valine	Lysine	Lysine	Lysine.
5	Lysine	Alanine[2]	Arginine[5]	Alanine[6]	Alanine.[7]
6	Arginine[1]	Arginine[2]	Valine[5]	Arginine[6]	Arginine.[7]
7	Valine[1]	Glycine[3]	Phenylalanine	Valine[6]	Valine.
8	Proline	Lysine[3]	Alanine	Phenylalanine	Phenylalanine.
9	Glycine	Phenylalanine	Proline	Glycine	Glycine.
10	Phenylalanine	Proline[4]	Glycine	Isoleucine	Proline.
11	Serine	Threonine[4]	Serine	Proline	Threonine.
12	Threonine	Isoleucine	Threonine	Threonine	Isoleucine.
13	Isoleucine	Serine	Isoleucine	Serine	Serine.
14	Tyrosine	Tyrosine	Tyrosine	Tyrosine	Tyrosine.
15	Histidine	Histidine	Histidine	Ammonia	Histidine.
16	Ammonia	Ammonia	Ammonia	Histidine	Methionine.
17	Methionine	Methionine	Methionine	Methionine	Ammonia.

[1]Arginine and valine were present in equal concentrations.
[2]Alanine and arginine were present in equal concentrations.
[3]Glycine and lysine were present in equal concentrations.
[4]Proline and threonine were present in equal concentrations.
[5]Arginine and valine were present in equal concentrations.
[6]Alanine, arginine, and valine were present in equal concentrations.
[7]Alanine and arginine were present in equal concentrations.

Table 3.—Amino acid and ammonia concentrations in leaves of yaupon sprayed with four herbicides at 2.24 kg ae per hectare on June 14, 1978[1]

Amino acid	Concentration (g/100 g tissue) in plants treated with[2]--				
	Untreated	3,6-DPA	Picloram	2,4,5-T	Triclopyr
Alanine.....	0.48a	0.50a	0.39b	0.38b	0.36b
Ammonia.....	.24a	.22a	.21a	.22a	.20a
Arginine.....	.48a	.50a	.40b	.37b	.34b
Aspartic acid....	.77ab	.81a	.72a-c	.69bc	.64c
Glutamic acid....	.90a	.93a	.76b	.72b	.68b
Glycine.....	.43ab	.46a	.39bc	.36c	.33c
Histidine.....	.18a	.18a	.13b	.12b	.11b
Isoleucine.....	.40a	.42a	.34b	.33b	.30b
Leucine.....	.76a	.80a	.63b	.60b	.56b
Lysine.....	.50a	.52a	.40b	.38b	.35b
Methionine.....	.16a	.16a	.14ab	.13b	.12b
Phenylalanine....	.47a	.50a	.40b	.38b	.36b
Proline.....	.39ab	.42a	.35bc	.34cd	.30c
Serine.....	.36ab	.40a	.34bc	.32bc	.29c
Threonine.....	.38ab	.41a	.35bc	.32cd	.29d
Tyrosine.....	.34a	.35a	.28b	.27b	.25b
Valine.....	.48ab	.50a	.42bc	.40c	.37c
Total.....	7.72a	8.07a	6.64b	6.34b	5.85b

[1]Leaf injury ratings were made on July 5, 1978; the percentage of leaf chlorosis or necrosis was 0% for untreated plants and for those treated with 3,6-DPA; 65% for plants treated with picloram; 82% for those treated with 2,4,5-T; and 85% for those treated with triclopyr. By Duncan's multiple-range test, these values would be assigned the following letters (those values having a common letter are not significantly different at the 5% level): 0c, 65b, 82a, 85a.

[2]Values given are means of samples collected in 1978 on June 16, 19, and 28 and on July 5. Values having a common letter within rows are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 4.--Leaf and stem chlorosis and necrosis in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and rated on 4 dates

Treatment[1]	Leaf and stem chlorosis and necrosis(%)[2]				
	Rating date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	10kl	71	13j-l	30f-k	15e
Atrazine.....	10kl	17i-l	40e-h	43e-g	28cd
Bromacil.....	71	23h-l	83a-c	83a-c	49b
2,4-D.....	71	10kl	17i-l	37f-i	18e
Dalapon.....	13j-l	70cd	80bc	83a-c	62a
Dicamba.....	71	10kl	17i-l	20i-l	13e
Glyphosate.....	71	67cd	90ab	93ab	64a
Hexazinone.....	71	13j-l	83a-c	100a	51b
Picloram.....	71	10kl	20i-l	33f-j	18e
2,4,5-T.....	10kl	23h-l	20i-l	27g-l	20de
Tebuthiuron....	10kl	13j-l	57de	47ef	32c
Triclopyr.....	71	10kl	17i-l	23h-l	17e
Mean.....	8d	24c	45b	52a	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 5.--Leaf and stem chlorosis and necrosis in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and rated on 4 dates

Treatment[1]	Leaf and stem chlorosis and necrosis(%)[2]				
	Rating date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	7gh	7gh	7gh	20f-h	10c
Atrazine.....	3h	7gh	57b-e	77a-c	36ab
Bromacil.....	3h	13f-h	33d-h	60b-e	28ab
2,4-D.....	10f-h	17f-h	47c-f	100a	43ab
Dalapon.....	10f-h	17f-h	60b-e	80a-c	42ab
Dicamba.....	7gh	13f-h	43c-g	100a	41ab
Glyphosate.....	7gh	17f-h	30e-h	87ab	35ab
Hexazinone.....	7gh	10f-h	67a-d	100a	46a
Picloram.....	7gh	17f-h	57b-e	100a	45ab
2,4,5-T.....	7gh	10f-h	30e-h	80a-c	32ab
Tebuthiuron....	3h	13f-h	70a-c	100a	47a
Triclopyr.....	7gh	10f-h	33d-h	97a	37ab
Mean.....	6c	12c	44b	83a	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 6.--Chlorosis and necrosis in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and rated on four dates

Treatment	Leaf and stem chlorosis and necrosis(%)[1]				
	Rating date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0f	0f	1f	1f	1b
3,6-DPA.....	2f	11d-f	82ab	100a	49a
Glyphosate.....	0f	8ef	65a-c	72ab	36a
Picloram.....	5ef	22c-f	85ab	100a	53a
2,4,5-T.....	5ef	6ef	40b-f	88ab	35a
Triclopyr.....	0f	16d-f	58a-d	52a-e	32a
Mean.....	2b	10b	56a	69a	....

[1]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 7.--Chlorosis and necrosis in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and rated on four dates

Treatment	Leaf and stem chlorosis and necrosis(%)[1]				
	Rating date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	1c	16bc	8c	8c	8b
2,4-D.....	10c	20bc	75a	100a	51a
3,6-DPA.....	5c	15bc	22bc	15bc	14b
Glyphosate.....	4c	4c	25bc	20bc	13b
Picloram.....	0c	40b	88a	100a	57a
Triclopyr.....	8c	40b	95a	95a	60a
Mean.....	4c	22b	52a	56a	....

[1]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 8.--Concentrations of total amino acids and ammonia in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	8.44c-l	8.24e-n	7.23l-p	6.08qr	7.50f
Atrazine.....	8.87a-h	9.98a	9.51a-d	8.19e-n	9.14a
Bromacil.....	9.16a-f	9.56a-c	8.01e-n	8.01e-n	8.69a-c
2,4-D.....	8.31d-m	8.13e-n	7.61i-o	7.33k-p	7.84ef
Dalapon.....	8.38c-l	7.73g-o	7.36j-o	6.79o-r	7.57f
Dicamba.....	8.22e-n	8.53b-k	7.97f-o	7.24l-p	7.99d-f
Glyphosate.....	8.37c-l	7.53i-o	6.20p-r	5.87r	6.99g
Hexazinone.....	9.22a-e	9.12a-f	8.95a-g	7.06n-q	8.59bc
Picloram.....	8.74b-i	8.73b-i	8.62b-i	7.12m-q	8.30c-e
2,4,5-T.....	8.12e-n	7.94f-o	8.33d-m	7.55i-o	7.98d-f
Tebuthiuron....	9.59a-c	9.48a-d	9.68ab	7.65no	9.10ab
Triclopyr.....	8.57b-j	9.07a-f	8.40c-l	7.96f-o	8.50cd
Mean.....	8.66a	8.67a	8.16b	7.24c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 9.--Concentrations of total amino acids and ammonia in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	10.14b-i	10.63b-f	9.74b-j	8.06g-o	9.64bc
Atrazine.....	10.87b-e	13.43a	11.14b-d	8.83e-m	11.07a
Bromacil.....	10.88b-e	11.90ab	11.64a-c	8.12g-o	10.63ab
2,4-D.....	10.03b-i	9.20d-l	7.62j-o	6.15o	8.25d
Dalapon.....	11.63a-c	10.41b-f	10.13b-i	8.88d-m	10.26ab
Dicamba.....	10.45b-f	8.95e-m	7.57j-o	6.74m-o	8.38d
Glyphosate.....	9.34d-k	9.47c-k	7.47k-o	7.41k-o	8.42d
Hexazinone.....	9.28d-k	10.51b-f	10.62b-f	6.24no	9.16cd
Picloram.....	10.62b-f	9.13d-l	7.93i-l	7.001-o	8.67cd
2,4,5-T.....	9.16d-l	10.31b-g	8.02h-o	8.14g-o	8.91cd
Tebuthiuron....	10.24b-h	11.84ab	10.46b-f	8.99d-m	10.40ab
Triclopyr.....	9.27d-k	8.82e-m	8.40f-n	7.55j-o	8.51d
Mean.....	10.16a	10.37a	9.23b	7.68c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 10.--Concentrations of total amino acids and ammonia in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	16.90a-d	16.93a-c	16.58b-e	17.10a-c	16.88a
3,6-DPA.....	17.90ab	16.41b-f	13.65g-i	12.48h-j	15.11b
Glyphosate.....	18.04ab	16.04c-f	13.83gh	12.19hi	15.02b
Picloram.....	16.40b-f	15.19d-g	14.18g	14.88e-g	15.16b
2,4,5-T.....	18.51a	16.85a-d	14.73f-g	10.82j	15.23b
Triclopyr.....	16.78a-d	14.23g	11.99ij	10.98j	13.49c
Mean.....	17.42a	15.94b	14.16c	13.08d	....

[1]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 11.--Concentrations of total amino acids and ammonia in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	10.41b	9.66b-d	10.16bc	9.27b-d	9.87a
2,4-D.....	10.24bc	8.22de	5.03f	4.28f	6.94b
3,6-DPA.....	12.82a	10.61b	8.18de	8.24de	9.96a
Glyphosate.....	9.95bc	10.10bc	9.31b-d	8.80c-e	9.54a
Picloram.....	9.50b-d	7.29e	4.29f	4.11f	6.30b
Triclopyr.....	8.76c-e	7.46e	5.44f	4.52f	6.54b
Mean.....	10.28a	8.89b	7.07c	6.54c	....

[1]Values having a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 12.—Changes in concentrations of amino acids and ammonia in roundseed dicanthelium (compared to untreated plants) after herbicide application

Herbicide and change in concentration[1]	Days after application[2]		
	7	14	27
Atrazine			
increased	Ala, Arg, Asp, Glu, Gly, Iso, Leu, Lys, Phe, Ser, Thr, Tyr, Val.	Arg, Asp, Glu, Gly, Iso, Lys, Phe, Ser, Thr, Val.	Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Phe, Ser, Thr, Tyr, Val.
Bromacil			
increased	Asp	Amm, Asp	Amm, Arg, Asp, Glu, Gly, His, Iso, Lys, Phe, Ser, Tyr, Val.
2,4-D			
increased			Arg, Gly, Iso, Val.
Dalapon:			
Increased		Asp, Glu, His	Asp, Glu.
Decreased	Ala, Arg, Gly, His, Leu, Lys, Phe, Tyr.	Ala, Leu	
Dicamba			
increased			Arg, Gly, His, Iso, Lys, Tyr.
Glyphosate:			
Increased	Glu	Glu	Glu.
Decreased	Ala, Arg, Gly, His, Iso, Leu, Lys, Met, Phe, Thr, Tyr, Val.	Ala, Arg, Gly, His, Iso, Leu, Lys, Met, Phe, Thr, Tyr, Val.	Iso, Leu, Phe, Tyr.
Hexazinone			
increased	Asp	Asp, Gly, Phe	Asp, Gly, Thr.
Picloram			
increased	Glu	Asp, Glu	Arg, Glu, Gly, His, Lys.
2,4,5-T			
increased		Asp, Gly, Val	Ala, Arg, Glu, Gly, His, Iso, Leu, Lys, Phe, Thr, Tyr, Val.
Tebuthiuron			
increased	Asp	Arg, Asp, Gly, Phe, Ser.	Ala, Arg, Asp, Glu, Gly, Iso, Lys, Ser, Thr, Tyr, Val.
Triclopyr			
increased	Asp, Glu	Asp, Glu	Ala, Arg, Glu, Gly, His, Iso, Leu, Lys, Phe, Ser, Thr, Tyr, Val.

[1] All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2] At 2 days after treatment, methionine decreased with dicamba, and alanine and valine increased with tebuthiuron.

Symbols: Ala = alanine, Amm = ammonia, Arg = arginine, Asp = aspartic acid, Glu = glutamic acid, Gly = glycine, His = histidine, Iso = isoleucine, Leu = leucine, Lys = lysine, Met = methionine, Phe = phenylalanine, Ser = serine, Thr = threonine, Tyr = tyrosine, Val = valine.

Table 13.--Changes in concentrations of amino acids and ammonia in western ragweed (compared to untreated plants) after herbicide application

Herbicide and change in concentration[1]	Days after application[2]		
	7	14	27
Atrazine			
increased	Ala, Amm, Arg, Asp, Glu, Gly, Iso, Leu, Lys, Phe, Ser, Thr, Tyr, Val.	Asp	
Bromacil			
increased	Amm, Asp	Asp	
2,4-D			
decreased	Met	Gly, His, Leu, Met, Phe, Thr, Tyr, Val.	Leu, Lys, Phe, Tyr, Val.
Dalapon:			
Increased			Glu.
Decreased	Met	Val	
Dicamba			
decreased	Leu, Met, Phe, Tyr, Val.	Arg, Gly, Leu, Phe, Thr, Tyr, Val.	
Glyphosate			
decreased		Ala, Arg, Gly, Iso, Leu, Met, Phe, Thr, Tyr, Val.	
Hexazinone:			
Increased	Amm, Asp	Amm, Asp	
Decreased			His, Leu, Lys, Met, Tyr, Val.
Picloram			
decreased		Gly, Leu, Phe, Thr, Tyr, Val.	
2,4,5-T			
decreased		Leu, Phe, Tyr, Val	
Tebuthiuron			
increased	Amm, Asp	Asp	
Triclopyr			
decreased	Leu, Met, Tyr, Val		

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]At 2 days after treatment, aspartic acid decreased with 2,4-D, and proline increased with dalapon.

Symbols: Ala = alanine, Amm = ammonia, Arg = arginine, Asp = aspartic acid, Glu = glutamic acid, Gly = glycine, His = histidine, Iso = isoleucine, Leu = leucine, Lys = lysine, Met = methionine, Phe = phenylalanine, Ser = serine, Thr = threonine, Tyr = tyrosine, Val = valine.

Table 14.--Changes[1] in concentrations of amino acids and ammonia in honey mesquite leaves (compared to untreated plants) after herbicide application (at 1.12 kg ae per hectare)

Herbicide	Days after application[2]		
	7	14	27
3,6-DPA	Tyr	Ala, Arg, Gly, His, Iso, Leu, Lys, Met, Phe, Ser, Thr, Tyr, Val.	Ala, Arg, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Ser, Thr, Tyr, Val.
Glyphosate		Ala, Arg, Gly, His, Iso, Leu, Lys, Met, Phe, Thr, Tyr, Val.	Ala, Amm, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Ser, Thr, Tyr, Val.
Picloram	Ala, Gly, Lys, Met, Phe, Thr, Tyr.	Ala, Arg, Gly, His, Iso, Leu, Lys, Met, Phe, Thr, Tyr, Val.	Ala, Arg, Gly, His, Leu, Lys, Met, Phe, Thr, Tyr, Val.
2,4,5-T		Ala, Amm, Gly, His, Lys, Met, Phe, Tyr.	Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Ser, Thr, Tyr, Val.
Triclopyr	Ala, Arg, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Thr, Tyr, Val.	Ala, Amm, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Ser, Thr, Tyr, Val.	Ala, Amm, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.

[1]All changes were decreases.

[2]At 2 days after treatment, arginine increased with 3,6-DPA and aspartic acid increased with 2,4,5-T. At 4 and 6 days, aspartic acid increased with 3,6-DPA and at 6 days with picloram.

Symbols: Ala = alanine, Amm = ammonia, Arg = arginine, Asp = aspartic acid, Glu = glutamic acid, Gly = glycine, His = histidine, Iso = isoleucine, Leu = leucine, Lys = lysine, Met = methionine, Phe = phenylalanine, Pro = proline, Ser = serine, Thr = threonine, Tyr = tyrosine, Val = valine.

Table 15.—Changes in concentrations of amino acids and ammonia in Macartney rose leaves (compared to untreated plants) after herbicide application (at 2.24 kg ae per hectare)

Herbicide and change in concentration	Days after application			
	2	4	8	18
2,4-D				
decreased		Ala, Iso, Leu, Met, Phe, Thr, Val.	Ala, Amm, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.	Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.
3,6-DPA:				
Increased	Ala, Amm, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.			
Decreased			Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Met, Phe, Pro, Ser, Thr, Tyr, Val.	His.
Glyphosate				
decreased			Met	
Picloram				
decreased		Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.	Ala, Amm, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.	Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.
Triclopyr				
decreased	Ala, Arg, Asp, Glu, His, Iso, Leu, Met, Phe, Pro, Thr, Tyr, Val.	Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.	Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.	Ala, Arg, Asp, Glu, Gly, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Val.

Symbols: Ala = alanine, Amm = ammonia, Arg = arginine, Asp = aspartic acid, Glu = glutamic acid, Gly = glycine, His = histidine, Iso = isoleucine, Leu = leucine, Lys = lysine, Met = methionine, Phe = phenylalanine, Pro = proline, Ser = serine, Thr = threonine, Tyr = tyrosine, Val = valine.

Table 16.--Alanine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Alanine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.60b-e	0.60b-e	0.55c-h	0.46i-l	0.56d
Atrazine.....	.64a-c	.70a	.61b-e	.57c-g	.63a
Bromacil.....	.67ab	.63a-c	.51f-j	.51f-j	.58cd
2,4-D.....	.60b-e	.58c-f	.57c-g	.54d-i	.57cd
Dalapon.....	.61b-e	.51f-j	.49g-j	.45j-l	.52e
Dicamba.....	.61b-e	.62a-d	.57c-g	.53e-j	.59b-d
Glyphosate.....	.62a-d	.50f-j	.40kl	.391	.48f
Hexazinone.....	.68ab	.61b-e	.53e-j	.48h-k	.57cd
Picloram.....	.63a-c	.61b-e	.60b-e	.51f-j	.59b-d
2,4,5-T.....	.60b-e	.57c-g	.60b-e	.56c-h	.62ab
Tebuthiuron....	.70a	.62a-d	.58c-f	.57c-g	.59b-d
Triclopyr.....	.62a-d	.62a-d	.57c-g	.57c-g	.58cd
Mean.....	.63a	.60b	.55c	.51d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 17.--Ammonia concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Ammonia concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.16b	0.17b	0.17b	0.14b	0.16c
Atrazine.....	.18b	.27ab	.41ab	.31ab	.29bc
Bromacil.....	.23ab	.43ab	.56a	.56a	.45a
2,4-D.....	.24ab	.28ab	.19b	.32ab	.26bc
Dalapon.....	.17b	.33ab	.23ab	.22b	.24bc
Dicamba.....	.25ab	.24ab	.40ab	.17b	.26bc
Glyphosate.....	.23ab	.30ab	.42ab	.36ab	.33b
Hexazinone.....	.21b	.28ab	.47ab	.29ab	.31bc
Picloram.....	.20b	.32ab	.27ab	.23ab	.25bc
2,4,5-T.....	.23ab	.21b	.25ab	.18b	.22bc
Tebuthiuron....	.30ab	.32ab	.43ab	.22b	.32b
Triclopyr.....	.19b	.27ab	.24ab	.21b	.23bc
Mean.....	.22a	.28a	.34a	.27a	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 18.--Arginine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Arginine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.55a-e	0.52b-g	0.44h-l	0.35mn	0.46ef
Atrazine.....	.56a-d	.60a	.55a-e	.48e-k	.55a
Bromacil.....	.57a-c	.55a-e	.48e-k	.48e-k	.52a-c
2,4-D.....	.53a-g	.50c-i	.48e-k	.43i-l	.48de
Dalapon.....	.51c-h	.44h-l	.42j-m	.39l-m	.44f
Dicamba.....	.52b-g	.53a-g	.47f-k	.46g-l	.50b-d
Glyphosate.....	.51c-h	.39lm	.29n	.30n	.37g
Hexazinone.....	.59ab	.53a-g	.51c-h	.41k-m	.51b-d
Picloram.....	.55a-e	.53a-g	.51c-h	.43i-l	.50b-d
2,4,5-T.....	.51c-h	.49d-j	.51c-h	.46g-l	.49c-e
Tebuthiuron....	.60a	.55a-e	.53a-g	.46g-l	.53ab
Triclopyr.....	.54c-f	.55a-e	.49d-j	.49d-j	.52a-c
Mean.....	.54a	.52b	.47c	.43d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 19.--Aspartic acid concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Aspartic acid concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.85e-m	0.82i-m	0.69mn	0.60n	0.74f
Atrazine.....	.91e-l	1.26d	1.88a	1.02e-h	1.27b
Bromacil.....	1.02e-h	1.56c	1.60bc	1.60bc	1.45a
2,4-D.....	.82i-m	.80i-m	.76j-n	.72l-n	.77ef
Dalapon.....	.88e-m	.92e-k	.97e-i	.88e-m	.91cd
Dicamba.....	.78i-n	.88e-m	.86f-m	.73k-n	.81ef
Glyphosate.....	.83h-m	.77j-n	.85g-m	.78e-n	.81ef
Hexazinone.....	1.02e-h	1.48c	1.66bc	.86f-m	1.26b
Picloram.....	.90e-l	.95e-j	1.07e	.74d-n	.92cd
2,4,5-T.....	.79i-n	.82i-m	.94e-j	.78e-n	.83de
Tebuthiuron....	1.05ef	1.58c	1.79b	.88e-m	1.32b
Triclopyr.....	.87f-m	1.04e-g	1.03e-g	.82i-n	.94c
Mean.....	.89c	1.07b	1.17a	.87c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 20.—Glutamic acid concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Glutamic acid concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	1.00f-j	0.98g-j	0.91i-k	0.78k	0.92g
Atrazine.....	1.04d-j	1.16b-f	1.10c-h	1.02e-j	1.08b-d
Bromacil.....	1.11c-g	1.06d-j	.99g-j	.99g-j	1.03d-f
2,4-D.....	1.02e-j	1.01f-j	.93i-k	.91i-k	.97fg
Dalapon.....	1.03e-j	1.06d-j	1.04d-j	.95g-j	1.02d-f
Dicamba.....	.98g-j	1.04d-j	1.02e-j	.90jk	.98e-g
Glyphosate.....	1.07d-i	1.39a	1.41a	1.16b-f	1.26a
Hexazinone.....	1.11c-g	1.02e-j	1.04d-j	.94h-k	1.03d-f
Picloram.....	1.07d-i	1.18b-e	1.26a-c	.98g-j	1.12bc
2,4,5-T.....	.99g-j	1.01f-j	1.03e-j	.95g-j	.99e-g
Tebuthiuron....	1.16b-f	1.06d-j	1.06d-j	.96g-j	1.06c-e
Triclopyr.....	1.06d-j	1.30ab	1.20b-d	1.00f-j	1.14b
Mean.....	1.05b	1.11a	1.08ab	.96c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 21.—Glycine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Glycine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.49b-g	0.48c-h	0.40j-l	0.34lm	0.43e
Atrazine.....	.53a-c	.56a	.51a-e	.47c-i	.52a
Bromacil.....	.53a-c	.51a-e	.46d-j	.46d-j	.49a-c
2,4-D.....	.48c-h	.46d-j	.46d-j	.41i-k	.45de
Dalapon.....	.49b-g	.41i-k	.42h-k	.39kl	.43e
Dicamba.....	.48c-h	.49b-g	.44f-k	.42h-k	.46c-e
Glyphosate.....	.48c-h	.39kl	.30m	.31m	.37f
Hexazinone.....	.52a-d	.48c-h	.47c-i	.43g-k	.48b-d
Picloram.....	.51a-e	.48c-h	.46d-j	.41i-k	.46c-e
2,4,5-T.....	.47c-i	.45e-k	.47c-i	.43g-k	.46c-e
Tebuthiuron....	.55ab	.50a-f	.49b-g	.46d-j	.50ab
Triclopyr.....	.50a-f	.49b-g	.45e-k	.46d-j	.48b-d
Mean.....	.50a	.47b	.44c	.42d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 22.--Histidine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Histidine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.19a-c	0.19a-c	0.17c-e	0.13gh	0.17b
Atrazine.....	.20ab	.21a	.19a-c	.16d-f	.19a
Bromacil.....	.20ab	.20ab	.16d-f	.16d-f	.18ab
2,4-D.....	.19a-c	.18b-d	.17c-e	.15e-g	.17b
Dalapon.....	.18b-d	.16d-f	.14f-h	.13gh	.15c
Dicamba.....	.19a-c	.19a-c	.17c-e	.16d-f	.18ab
Glyphosate.....	.19a-c	.16d-f	.14f-h	.13gh	.15c
Hexazinone.....	.20ab	.19a-c	.16d-f	.12h	.17b
Picloram.....	.20ab	.19a-c	.18b-d	.16d-f	.18ab
2,4,5-T.....	.18b-d	.17c-e	.18b-d	.16d-f	.18ab
Tebuthiuron....	.21a	.20ab	.18b-d	.15e-g	.18ab
Triclopyr.....	.19a-c	.20ab	.18b-d	.17c-e	.18ab
Mean.....	.19a	.19a	.17b	.15c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 23.--Isoleucine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Isoleucine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.40b-f	0.39c-g	0.34g-j	0.28k	0.35de
Atrazine.....	.42a-d	.46a	.40b-f	.36e-i	.41a
Bromacil.....	.43a-c	.41a-e	.34g-j	.34g-j	.38bc
2,4-D.....	.39c-g	.37d-h	.36e-i	.34g-j	.36c-e
Dalapon.....	.40b-f	.35f-i	.31i-k	.29jk	.34e
Dicamba.....	.38c-g	.39c-g	.36e-i	.34g-j	.37b-d
Glyphosate.....	.38c-g	.29jk	.211	.221	.28f
Hexazinone.....	.43a-c	.40b-f	.36e-i	.31i-k	.37b-d
Picloram.....	.41a-e	.39c-g	.37d-h	.32h-k	.37b-d
2,4,5-T.....	.38c-g	.37d-h	.38c-g	.36e-i	.37b-d
Tebuthiuron....	.45ab	.41a-e	.38c-g	.35f-i	.39ab
Triclopyr.....	.40b-f	.40b-f	.36e-i	.37d-h	.38bc
Mean.....	.40a	.39b	.35c	.32d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 24.—Leucine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Leucine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.76a-e	0.74b-g	0.68e-k	0.57l-o	0.69b
Atrazine.....	.81a-c	.85a	.73c-h	.68e-k	.77a
Bromacil.....	.80a-d	.75b-f	.62i-o	.62i-o	.70b
2,4-D.....	.73c-h	.69e-j	.69e-j	.66f-l	.69b
Dalapon.....	.74b-g	.61j-o	.58l-o	.54o	.62c
Dicamba.....	.73c-h	.74b-g	.68e-k	.65g-m	.70b
Glyphosate.....	.72c-h	.55no	.39p	.40p	.52d
Hexazinone.....	.80a-d	.73c-h	.64h-n	.56m-o	.68b
Picloram.....	.77a-e	.73c-h	.71d-i	.56k-o	.70b
2,4,5-T.....	.71d-i	.70e-j	.72c-h	.69e-j	.71b
Tebuthiuron....	.83ab	.74b-g	.69e-j	.66f-l	.73ab
Triclopyr.....	.76a-e	.74b-g	.70e-j	.71d-i	.73ab
Mean.....	.76a	.72b	.65c	.61d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 25.—Lysine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Lysine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.57a-g	0.54d-i	0.46j-n	0.36op	0.48de
Atrazine.....	.59a-e	.64a	.56b-h	.50f-l	.57a
Bromacil.....	.61a-d	.57a-g	.48h-l	.48h-l	.53bc
2,4-D.....	.56b-h	.53e-j	.50f-l	.44p-t	.51cd
Dalapon.....	.55c-i	.46j-n	.43l-n	.39no	.46e
Dicamba.....	.55c-i	.56b-h	.49g-l	.47i-m	.52bc
Glyphosate.....	.55c-i	.43l-n	.31p	.32p	.40f
Hexazinone.....	.62a-c	.55c-i	.49g-l	.40m-o	.52bc
Picloram.....	.58a-f	.56b-h	.52e-k	.45k-n	.53bc
2,4,5-T.....	.54d-i	.52e-k	.53e-j	.46j-n	.51cd
Tebuthiuron....	.63ab	.56b-h	.53e-j	.47i-m	.55ab
Triclopyr.....	.57a-g	.57a-g	.50f-l	.50f-l	.53bc
Mean.....	.58a	.54b	.48c	.44d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 26.--Methionine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Methionine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.15a-c	0.15a-c	0.13b-d	0.11de	0.13cd
Atrazine.....	.16ab	.17a	.16ab	.13b-d	.16a
Bromacil.....	.14a-d	.15a-c	.12cd	.12cd	.13cd
2,4-D.....	.13b-d	.14a-d	.14a-d	.11de	.13cd
Dalapon.....	.15a-c	.12cd	.11de	.11de	.12d
Dicamba.....	.11de	.15a-c	.12cd	.12cd	.12d
Glyphosate.....	.13b-d	.11de	.08e	.08e	.10e
Hexazinone.....	.16ab	.15a-c	.14a-d	.11de	.14bc
Picloram.....	.14a-d	.12cd	.15a-c	.12cd	.13cd
2,4,5-T.....	.14a-d	.14a-d	.14a-d	.13b-d	.14bc
Tebuthiuron....	.17a	.16ab	.14a-d	.13b-d	.15ab
Triclopyr.....	.15a-c	.16ab	.14a-d	.14a-d	.15ab
Mean.....	.14a	.14a	.13b	.12c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 27.—Phenylalanine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Phenylalanine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.47b-f	0.46b-g	0.40g-l	0.34lm	0.42d
Atrazine.....	.49a-e	.54a	.50a-d	.43e-i	.49a
Bromacil.....	.50a-d	.49a-e	.45c-h	.45c-h	.47ab
2,4-D.....	.45c-h	.45c-h	.42f-k	.40g-l	.43cd
Dalapon.....	.44d-i	.39h-m	.36k-m	.33m	.38e
Dicamba.....	.45c-h	.56b-g	.42f-k	.40g-l	.43cd
Glyphosate.....	.43e-i	.34lm	.25n	.26n	.32f
Hexazinone.....	.49a-e	.49a-e	.47b-f	.35lm	.45bc
Picloram.....	.48a-f	.46b-g	.43e-i	.38i-m	.44cd
2,4,5-T.....	.44d-i	.43e-i	.46b-g	.42f-k	.44cd
Tebuthiuron....	.52ab	.51a-c	.47b-f	.40g-l	.47ab
Triclopyr.....	.46b-g	.47b-f	.43e-i	.44d-i	.45bc
Mean.....	.47a	.46a	.42b	.38c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 28.--Proline concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Proline concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.49a-f	0.46a-h	0.43d-i	0.39h-j	0.44cd
Atrazine.....	.53ab	.55a	.47a-h	.44c-i	.50a
Bromacil.....	.50a-e	.46b-i	.39h-j	.39h-j	.43d
2,4-D.....	.47a-h	.45b-i	.40g-j	.41f-j	.43d
Dalapon.....	.52a-c	.48a-g	.46b-i	.42e-j	.47a-c
Dicamba.....	.48a-g	.48a-g	.42e-j	.42e-j	.45b-d
Glyphosate.....	.52a-c	.48a-g	.38i-j	.34j	.43d
Hexazinone.....	.50a-e	.46b-i	.41f-j	.38i-j	.44cd
Picloram.....	.51a-d	.48a-g	.46b-i	.39h-j	.46b-d
2,4,5-T.....	.47a-h	.45b-i	.46b-i	.43d-i	.45b-d
Tebuthiuron....	.53ab	.47a-h	.43d-i	.42e-j	.46b-d
Triclopyr.....	.50a-e	.51a-d	.47a-h	.44c-i	.48ab
Mean.....	.50a	.48b	.43c	.40d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 29.--Serine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Serine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.42b-g	0.41c-h	0.36g-j	0.31j	0.38d
Atrazine.....	.44a-e	.49a	.45a-d	.42b-g	.45a
Bromacil.....	.47a-c	.47a-c	.38e-i	.38e-i	.43a-c
2,4-D.....	.43a-f	.42b-g	.39d-i	.36g-j	.40cd
Dalapon.....	.42b-g	.39d-i	.37f-j	.34ij	.38d
Dicamba.....	.43a-f	.43a-f	.39d-i	.37f-j	.41b-d
Glyphosate.....	.43a-f	.45a-d	.38e-i	.35h-j	.40cd
Hexazinone.....	.48ab	.45a-d	.41c-h	.37f-j	.43a-c
Picloram.....	.45a-d	.44a-e	.42b-g	.36g-j	.42a-c
2,4,5-T.....	.42b-g	.41c-h	.41c-h	.37f-j	.40cd
Tebuthiuron....	.49a	.43a-f	.43a-f	.38e-i	.44ab
Triclopyr.....	.45a-d	.41c-h	.41c-h	.40d-i	.43a-c
Mean.....	.44a	.44a	.40b	.37c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 30.--Threonine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Threonine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.43a-e	0.41b-g	0.35g-k	0.29k-m	0.37ef
Atrazine.....	.46ab	.48a	.44a-d	.40b-h	.44a
Bromacil.....	.45a-c	.44a-d	.38d-j	.38d-j	.42bc
2,4-D.....	.42a-f	.39c-i	.38d-j	.35g-k	.38d-f
Dalapon.....	.42a-e	.35g-k	.35g-k	.33i-k	.36f
Dicamba.....	.42a-f	.42a-f	.38d-j	.36f-j	.39c-e
Glyphosate.....	.42a-f	.32j-l	.25m	.26lm	.31g
Hexazinone.....	.46ab	.42b-f	.39c-i	.38d-j	.41bc
Picloram.....	.45a-c	.42a-f	.39c-i	.34h-k	.40cd
2,4,5-T.....	.40b-h	.39c-i	.40b-h	.37e-j	.39c-e
Tebuthiuron....	.48a	.44a-d	.41b-g	.38d-j	.43ab
Triclopyr.....	.42a-f	.43a-e	.40b-h	.40b-h	.41bc
Mean.....	.44a	.41b	.38c	.35d	....

[1] All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2] Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 31.--Tyrosine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Tyrosine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.37a-e	0.36b-f	0.32e-i	0.27ij	0.33c
Atrazine.....	.38a-d	.42a	.35c-g	.33d-h	.37a
Bromacil.....	.38a-d	.33d-h	.30g-j	.30g-j	.33c
2,4-D.....	.35c-g	.35c-g	.33d-h	.31f-j	.34bc
Dalapon.....	.35c-g	.30g-j	.27ij	.26jk	.29d
Dicamba.....	.35c-g	.36b-f	.32e-i	.32e-i	.34bc
Glyphosate.....	.34c-h	.26jk	.191	.21kl	.25e
Hexazinone.....	.39a-c	.35c-g	.32e-i	.26jk	.33c
Picloram.....	.37a-e	.36b-f	.33d-h	.29h-j	.34bc
2,4,5-T.....	.34c-h	.33d-h	.35c-g	.33d-h	.34bc
Tebuthiuron....	.41ab	.36b-f	.33d-h	.31f-j	.35a-c
Triclopyr.....	.37a-e	.36b-f	.34c-h	.35c-h	.36ab
Mean.....	.37a	.34b	.31c	.30d	....

[1] All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2] Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 32.--Valine concentrations in roundseed dicanthelium sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Valine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.51c-f	0.50c-g	0.44g-k	0.371m	0.46de
Atrazine.....	.55a-d	.60a	.53b-e	.48e-i	.54a
Bromacil.....	.56a-c	.55a-d	.46f-k	.46f-k	.51a-c
2,4-D.....	.51c-f	.49d-h	.46f-k	.44g-k	.48c-e
Dalapon.....	.52c-f	.47e-j	.43h-l	.40kl	.45e
Dicamba.....	.50c-g	.51c-f	.47e-j	.43h-l	.48c-e
Glyphosate.....	.50c-g	.41j-l	.31n	.32mn	.38f
Hexazinone.....	.56a-c	.52c-f	.48e-i	.42i-l	.50bc
Picloram.....	.53b-e	.51c-f	.49d-h	.42i-l	.49b-d
2,4,5-T.....	.50c-g	.48e-i	.50c-f	.46f-k	.49b-d
Tebuthiuron....	.59ab	.55a-d	.50c-g	.46f-k	.52ab
Triclopyr.....	.52c-f	.52c-f	.48e-i	.48e-i	.50bc
Mean.....	.53a	.51b	.46c	.43d	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 33.--Alanine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Alanine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.64b-g	0.67b-d	0.62b-i	0.50f-m	0.61bc
Atrazine.....	.67b-d	.83a	.67b-d	.55d-l	.68a
Bromacil.....	.68b-d	.70a-c	.72ab	.51e-m	.65ab
2,4-D.....	.59b-k	.58c-k	.46i-m	.37m	.50d
Dalapon.....	.71a-c	.63b-h	.61b-j	.49g-m	.61bc
Dicamba.....	.66b-e	.55d-l	.47h-m	.42lm	.52d
Glyphosate.....	.59b-k	.59b-k	.45j-m	.44k-m	.52d
Hexazinone.....	.59b-k	.62b-i	.63b-h	.40lm	.56d
Picloram.....	.65b-f	.58c-k	.47h-m	.44k-m	.53d
2,4,5-T.....	.58c-k	.63b-h	.49g-m	.51e-m	.55cd
Tebuthiuron....	.65b-f	.71a-c	.62b-i	.58c-k	.64ab
Triclopyr.....	.59b-k	.54d-l	.51e-m	.47h-m	.53d
Mean.....	.63a	.64a	.56b	.47c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 34.--Ammonia concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Ammonia concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.21e-g	0.23d-g	0.22d-g	0.21e-g	0.22d
Atrazine.....	.28b-g	.42a-c	.38a-f	.34a-g	.35a
Bromacil.....	.26c-g	.42a-c	.33a-g	.22d-g	.31b
2,4-D.....	.24c-g	.24c-g	.21e-g	.27c-g	.24d
Dalapon.....	.28b-g	.40a-d	.27c-g	.31a-g	.31b
Dicamba.....	.33a-g	.21e-g	.19g	.24c-g	.24d
Glyphosate.....	.24c-g	.39a-e	.23d-g	.25c-g	.28c
Hexazinone.....	.24c-g	.46ab	.47a	.22d-g	.35a
Picloram.....	.23d-g	.23d-g	.23d-g	.24c-g	.23d
2,4,5-T.....	.21e-g	.26c-g	.21e-g	.25c-g	.23d
Tebuthiuron....	.24c-g	.48a	.40a-d	.26c-g	.34a
Triclopyr.....	.20fg	.32a-g	.23d-g	.24c-g	.25d
Mean.....	.25b	.34a	.28b	.26b	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 35.--Arginine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Arginine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.65b-h	0.67b-f	0.62b-k	0.49i-r	0.61bc
Atrazine.....	.67b-f	.83a	.69a-e	.53f-p	.68a
Bromacil.....	.67b-f	.72a-c	.74ab	.49i-r	.66ab
2,4-D.....	.64b-i	.56e-n	.48j-r	.34r	.51d
Dalapon.....	.71a-d	.62b-k	.61b-l	.50h-r	.61bc
Dicamba.....	.65b-h	.53f-p	.451-r	.38p-r	.50d
Glyphosate.....	.57d-n	.58c-m	.44m-r	.42n-r	.50d
Hexazinone.....	.58c-m	.62b-k	.65b-h	.37qr	.55cd
Picloram.....	.66b-g	.55e-o	.47k-r	.40o-r	.52d
2,4,5-T.....	.57d-n	.63b-j	.48j-r	.48j-r	.54d
Tebuthiuron....	.64b-i	.72a-c	.66b-g	.53f-p	.64ab
Triclopyr.....	.58c-m	.53f-p	.51g-q	.44m-r	.51d
Mean.....	.63a	.63a	.57b	.45c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 36.--Aspartic acid concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Aspartic acid concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	1.07e-j	1.12e-i	1.02f-k	0.85h-n	1.01b
Atrazine.....	1.22d-g	1.52a-d	1.55a-c	.96f-l	1.31a
Bromacil.....	1.27b-f	1.67a	1.38a-e	.89g-l	1.30a
2,4-D.....	.681	.98f-l	.83i-l	.681	.79c
Dalapon.....	1.24c-g	1.11e-i	1.17e-i	1.18e-h	1.18a
Dicamba.....	1.09e-i	.92g-l	.82i-l	.77j-l	.90bc
Glyphosate.....	.99f-l	.99f-l	.84h-l	.84h-l	.91bc
Hexazinone.....	1.06e-j	1.57ab	1.59a	.74k-l	1.24a
Picloram.....	1.14e-i	.96f-l	1.02f-k	.731	.96b
2,4,5-T.....	.96f-l	1.18e-h	.97f-l	.93f-l	1.01b
Tebuthiuron....	1.14e-i	1.60a	1.50a-d	1.04f-k	1.32a
Triclopyr.....	.97f-l	.91g-l	.91g-l	.86h-l	.91bc
Mean.....	1.06ab	1.21a	1.13ab	.87c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 37.--Glutamic acid concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Glutamic acid concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	1.18b-m	1.23b-j	1.13c-m	0.921-q	1.12bc
Atrazine.....	1.28a-g	1.53a	1.32a-f	1.04f-p	1.30a
Bromacil.....	1.27a-g	1.34a-d	1.36a-c	.97h-q	1.23ab
2,4-D.....	1.21b-l	1.10c-o	.921-q	.74q	.99c
Dalapon.....	1.43ab	1.28a-g	1.33a-e	1.24b-i	1.32a
Dicamba.....	1.22b-k	1.05e-p	.91m-q	.83o-q	1.00c
Glyphosate.....	1.14c-m	1.12c-n	.96i-q	.97h-q	1.05c
Hexazinone.....	1.08c-p	1.16b-m	1.25b-h	.80pq	1.07c
Picloram.....	1.27a-g	1.08c-p	.93k-q	.85n-q	1.03c
2,4,5-T.....	1.07d-p	1.23b-j	.93k-q	1.00g-q	1.06c
Tebuthiuron....	1.18b-m	1.33a-e	1.23b-j	1.12c-n	1.22ab
Triclopyr.....	1.11d-o	1.04f-q	1.01g-q	.94j-g	1.02c
Mean.....	1.20a	1.21a	1.11b	0.95c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 38.--Glycine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Glycine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.60b-i	0.64b-e	0.58b-i	0.48h-n	0.58bc
Atrazine.....	.64b-e	.79a	.63b-f	.54d-l	.65a
Bromacil.....	.64b-e	.66b-d	.69ab	.49g-m	.62ab
2,4-D.....	.57b-j	.55d-k	.45j-n	.36n	.48d
Dalapon.....	.68a-c	.61b-h	.60b-i	.49g-m	.60ab
Dicamba.....	.62b-g	.52e-l	.45j-n	.42l-n	.50d
Glyphosate.....	.55d-k	.54d-l	.42l-n	.43l-p	.49d
Hexazinone.....	.55d-k	.58b-i	.60b-i	.38mn	.53cd
Picloram.....	.62b-g	.53d-l	.45j-n	.43k-n	.51d
2,4,5-T.....	.54d-l	.60b-i	.47h-n	.50f-m	.53cd
Tebuthiuron....	.60b-i	.67b-d	.60b-i	.55d-k	.60ab
Triclopyr.....	.55c-j	.51e-l	.49g-m	.46i-n	.50d
Mean.....	.60a	.60a	.54b	.46c	....

[1] All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2] Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 39.—Histidine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Histidine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.23b-e	0.24a-d	0.22b-f	0.18e-i	0.22ab
Atrazine.....	.24a-d	.29a	.24a-d	.19d-h	.24a
Bromacil.....	.24a-d	.25ab	.24a-d	.18e-i	.23a
2,4-D.....	.23b-e	.21b-g	.16g-k	.13i-k	.18c
Dalapon.....	.25a-c	.22b-f	.21b-g	.19d-h	.22ab
Dicamba.....	.23b-e	.20c-h	.18e-i	.14h-k	.19c
Glyphosate.....	.21b-g	.20c-h	.19d-h	.16g-k	.19c
Hexazinone.....	.20c-h	.23b-e	.21b-g	.12k	.19c
Picloram.....	.24a-d	.21b-g	.18e-i	.15h-k	.20bc
2,4,5-T.....	.20c-h	.23b-e	.18e-i	.18e-i	.20bc
Tebuthiuron....	.23b-e	.26ab	.21b-g	.17f-k	.22ab
Triclopyr.....	.21b-g	.20c-h	.19d-h	.16g-k	.19c
Mean.....	.23a	.23a	.20b	.16c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 40.--Isoleucine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Isoleucine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.50b-h	0.53b-f	0.48b-j	0.40h-n	0.48b-d
Atrazine.....	.54b-e	.65a	.52b-g	.43e-1	.54a
Bromacil.....	.54b-e	.56a-c	.57a-c	.40h-n	.52ab
2,4-D.....	.49b-i	.46c-k	.37j-n	.29n	.40e
Dalapon.....	.58ab	.53b-f	.50b-h	.42f-1	.51ab
Dicamba.....	.52b-g	.43e-1	.37j-n	.341-n	.42e
Glyphosate.....	.46c-k	.47b-k	.36k-n	.36k-n	.41e
Hexazinone.....	.46c-k	.48b-j	.48b-j	.30mn	.43de
Picloram.....	.53b-f	.46c-k	.38i-n	.341-n	.43de
2,4,5-T.....	.46c-k	.51b-h	.42f-1	.40h-n	.45c-e
Tebuthiuron....	.51b-h	.55a-d	.49b-i	.44d-1	.50a-c
Triclopyr.....	.47b-k	.46c-k	.41g-m	.40h-n	.44de
Mean.....	.50a	.51a	.45b	.38c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 41.—Leucine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Leucine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.94b-f	1.01bc	0.91b-h	0.74f-n	0.90a
Atrazine.....	1.00bc	1.23a	.94b-f	.78e-m	.99a
Bromacil.....	.99b-d	1.02bc	1.03bc	.71h-p	.94a
2,4-D.....	.90b-i	.84c-l	.67j-p	.51p	.73b
Dalapon.....	1.07ab	.93b-g	.88b-i	.72h-o	.90a
Dicamba.....	.97b-e	.79d-m	.67j-p	.57n-p	.75b
Glyphosate.....	.85c-k	.84c-l	.62m-p	.62m-p	.73b
Hexazinone.....	.84c-l	.88b-i	.88b-i	.52op	.78b
Picloram.....	.97b-e	.84c-l	.65k-p	.59m-p	.76b
2,4,5-T.....	.84c-l	.91b-h	.69i-p	.70i-p	.79b
Tebuthiuron....	.95b-e	1.02bc	.88b-i	.78e-m	.91a
Triclopyr.....	.86b-j	.78e-m	.73g-n	.641-p	.75b
Mean.....	.93a	.92a	.80b	.66c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 42.--Lysine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Lysine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.62b-h	0.64b-f	0.59b-i	0.49f-m	0.58c-e
Atrazine.....	.69a-d	.82a	.66b-e	.50f-m	.67a
Bromacil.....	.66b-e	.74ab	.72a-c	.49f-m	.65ab
2,4-D.....	.67a-d	.58c-k	.48g-n	.32op	.52ef
Dalapon.....	.72a-c	.63b-g	.59b-i	.48g-n	.60a-c
Dicamba.....	.66b-e	.55d-k	.48g-n	.33h-p	.51f
Glyphosate.....	.61b-i	.60b-i	.46i-p	.42k-p	.52ef
Hexazinone.....	.58c-k	.64b-f	.57c-k	.31p	.52ef
Picloram.....	.68a-d	.58c-k	.48g-n	.36m-p	.53d-f
2,4,5-T.....	.57c-k	.64b-f	.51e-m	.43k-p	.54d-f
Tebuthiuron....	.60b-i	.72a-c	.58c-k	.47h-o	.59b-d
Triclopyr.....	.60b-i	.55d-k	.54d-l	.39l-p	.52ef
Mean.....	.64a	.64a	.56b	.42c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 43.--Methionine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Methionine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.20b-f	0.23a-c	0.19b-g	0.16e-j	0.20ab
Atrazine.....	.22b-d	.28a	.22b-d	.17d-i	.22a
Bromacil.....	.22b-d	.23a-c	.23a-c	.16e-j	.21ab
2,4-D.....	.20b-f	.15f-k	.13h-k	.11jk	.15e
Dalapon.....	.23a-c	.17d-i	.19b-g	.15f-k	.19bc
Dicamba.....	.20b-f	.17d-i	.14g-k	.12i-k	.16de
Glyphosate.....	.18c-h	.18c-h	.13h-k	.13h-k	.16de
Hexazinone.....	.19b-g	.20b-f	.19b-g	.10k	.17c-e
Picloram.....	.22b-d	.18c-h	.14g-k	.13h-k	.17c-e
2,4,5-T.....	.18c-h	.21b-e	.15f-k	.15f-k	.17c-e
Tebuthiuron....	.21b-e	.24ab	.19b-g	.17d-i	.20ab
Triclopyr.....	.19b-g	.17d-i	.16e-j	.13h-k	.16de
Mean.....	.20a	.20a	.17b	.14c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 44.—Phenylalanine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Phenylalanine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.58b-g	0.62b-d	0.57b-h	0.46h-n	0.56bc
Atrazine.....	.61b-e	.76a	.60b-e	.49e-m	.62a
Bromacil.....	.62b-d	.65b	.64bc	.45h-o	.59ab
2,4-D.....	.54b-i	.53b-j	.42i-l	.33o	.46d
Dalapon.....	.64bc	.57b-h	.54b-i	.47f-m	.55bc
Dicamba.....	.60b-e	.49e-m	.42i-o	.37m-o	.47d
Glyphosate.....	.51d-k	.52c-k	.41j-o	.40k-o	.46d
Hexazinone.....	.53b-j	.59b-f	.57b-h	.34no	.50cd
Picloram.....	.60b-e	.53b-j	.42i-l	.381-o	.48d
2,4,5-T.....	.52c-k	.57b-h	.43i-o	.41j-o	.48d
Tebuthiuron....	.59b-f	.65b	.56b-h	.49e-m	.57ab
Triclopyr.....	.53b-j	.50d-l	.47f-m	.41j-o	.48d
Mean.....	.57a	.58a	.50b	.42c	....

[1] All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2] Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 45.--Proline concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Proline concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.53c-h	0.57a-f	0.51c-i	0.46c-k	0.52a-d
Atrazine.....	.60a-c	.69ab	.53c-h	.45d-k	.57a
Bromacil.....	.54c-h	.57a-f	.58a-e	.44e-k	.53a-c
2,4-D.....	.53c-h	.47c-k	.42g-k	.43f-k	.46d
Dalapon.....	.70a	.56a-g	.51c-i	.44e-k	.55ab
Dicamba.....	.54c-h	.49c-i	.43f-k	.35jk	.45d
Glyphosate.....	.51c-i	.49c-i	.43f-k	.38i-k	.45d
Hexazinone.....	.48c-j	.49c-i	.51c-i	.33k	.45d
Picloram.....	.56a-g	.47c-k	.47c-k	.40h-k	.47cd
2,4,5-T.....	.50c-i	.59a-e	.43f-k	.44e-k	.49b-d
Tebuthiuron....	.55b-g	.58a-e	.50c-i	.48c-j	.53a-c
Triclopyr.....	.45d-k	.48c-j	.46c-k	.42g-k	.46d
Mean.....	.54a	.54a	.48b	.42c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 46.—Serine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Serine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.50b-f	0.50b-f	0.48b-f	0.41e-g	0.47bc
Atrazine.....	.51a-e	.61a	.52a-e	.46b-f	.53a
Bromacil.....	.52a-e	.54a-c	.55ab	.43c-g	.51a
2,4-D.....	.47b-f	.47b-f	.39fg	.34g	.42e
Dalapon.....	.55ab	.52a-e	.52a-e	.46b-f	.51a
Dicamba.....	.52a-e	.45b-f	.41e-g	.39fg	.44c-e
Glyphosate.....	.45b-f	.47b-f	.39fg	.41e-g	.43de
Hexazinone.....	.45b-f	.48b-f	.50b-f	.33g	.44c-e
Picloram.....	.51a-e	.47b-f	.41e-g	.41e-g	.45c-e
2,4,5-T.....	.45b-f	.51a-e	.42d-g	.45b-f	.46cd
Tebuthiuron....	.49b-f	.53a-d	.49b-f	.47b-f	.50ab
Triclopyr.....	.47b-f	.45b-f	.45b-f	.42d-g	.45c-e
Mean.....	.49a	.50a	.46b	.42c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 47.--Threonine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Threonine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.55b-i	0.56b-h	0.53b-j	0.43i-p	0.52bc
Atrazine.....	.60a-d	.70a	.56b-h	.46f-o	.58a
Bromacil.....	.57b-g	.59b-e	.61a-c	.44h-p	.55ab
2,4-D.....	.53b-j	.48d-n	.391-p	.32p	.43d
Dalapon.....	.63ab	.53b-j	.53b-j	.46f-o	.54ab
Dicamba.....	.55b-i	.47e-n	.40k-p	.38m-p	.45d
Glyphosate.....	.50c-l	.49c-m	.391-p	.391-p	.44d
Hexazinone.....	.49c-m	.50c-l	.52b-k	.34op	.46d
Picloram.....	.58b-f	.49c-m	.40k-p	.37n-p	.46d
2,4,5-T.....	.49c-m	.53b-j	.41j-p	.45g-o	.47cd
Tebuthiuron....	.54b-i	.59b-e	.52b-k	.49c-m	.54ab
Triclopyr.....	.49c-m	.46f-o	.45g-o	.41j-p	.45d
Mean.....	.54a	.53a	.48b	.41c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 48.--Tyrosine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Tyrosine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.47b-d	0.50b	0.45b-f	0.37d-l	0.44ab
Atrazine.....	.49b	.60a	.45b-f	.38c-k	.48a
Bromacil.....	.48bc	.50b	.50b	.35f-m	.46ab
2,4-D.....	.43b-g	.41b-i	.32h-m	.25m	.35c
Dalapon.....	.50b	.43b-g	.42b-h	.36e-l	.43b
Dicamba.....	.47b-d	.38c-k	.32h-m	.271m	.36b
Glyphosate.....	.40b-j	.40b-j	.31i-m	.32h-m	.36c
Hexazinone.....	.41b-i	.43b-g	.42b-h	.25m	.38c
Picloram.....	.47b-d	.41b-i	.32h-m	.28k-m	.37c
2,4,5-T.....	.41b-i	.44b-f	.33g-m	.33g-m	.38c
Tebuthiuron....	.46b-e	.50b	.42b-h	.37d-l	.44ab
Triclopyr.....	.42b-h	.38c-k	.36e-l	.30j-m	.36c
Mean.....	.45a	.45a	.38b	.32c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 49.--Valine concentrations in western ragweed sprayed with 11 herbicides on Apr. 26, 1978, and sampled on 4 dates

Treatment[1]	Valine concentration (g/100 g moisture-free tissue)[2]				
	Sampling date (days after spraying)				Mean
	Apr. 28 (2)	May 3 (7)	May 10 (14)	May 23 (27)	
Untreated.....	0.66b-g	0.68b-e	0.62b-j	0.51j-p	0.62bc
Atrazine.....	.68b-e	.84a	.68b-e	.55g-p	.69a
Bromacil.....	.69b-d	.72a-c	.74ab	.51j-p	.67ab
2,4-D.....	.61b-k	.59c-l	.47m-q	.38q	.51d
Dalapon.....	.74ab	.67b-f	.63b-i	.52i-p	.64ab
Dicamba.....	.66b-g	.56f-o	.481-q	.44pq	.53d
Glyphosate.....	.59c-l	.60b-k	.46n-q	.45o-q	.53d
Hexazinone.....	.59c-l	.61b-k	.60b-k	.39q	.55d
Picloram.....	.68b-e	.58d-m	.481-q	.44pq	.55d
2,4,5-T.....	.60b-k	.64b-h	.50k-q	.52i-p	.57cd
Tebuthiuron....	.66b-g	.72a-c	.63b-i	.57e-n	.65ab
Triclopyr.....	.59c-l	.55g-p	.53h-p	.47m-q	.53d
Mean.....	.65a	.65a	.57b	.48c	....

[1]All herbicides were applied at 1.12 kg ai (or ae) per hectare except atrazine (2.2 kg/ha) and dalapon (5.6 kg/ha).

[2]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 50.--Alanine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Alanine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.01a-c	1.02a-c	1.02a-c	1.02a-c	1.02a
3,6-DPA.....	1.05ab	.90c-g	.71i-l	.70i-l	.84b
Glyphosate.....	1.08ab	.94b-f	.78g-j	.75h-k	.89b
Picloram.....	.98a-c	.84e-i	.76g-k	.86d-h	.86b
2,4,5-T.....	1.11a	.99a-d	.86d-h	.591	.89b
Triclopyr.....	.98a-e	.80f-j	.68j-l	.62kl	.77c
Mean.....	1.04a	.92b	.80c	.76c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 51.—Ammonia concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Ammonia concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.32bc	0.34a-c	0.41ab	0.41ab	0.37ab
3,6-DPA.....	.32bc	.43a	.43a	.37a-c	.39a
Glyphosate.....	.36a-c	.34a-c	.36a-c	.27c	.33bc
Picloram.....	.32bc	.42a	.41ab	.42a	.39a
2,4,5-T.....	.34a-c	.36a-c	.30c	.32bc	.33bc
Triclopyr.....	.32bc	.32bc	.28c	.26c	.29c
Mean.....	.33a	.37a	.36a	.34a	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 52.—Arginine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Arginine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.04bc	1.06bc	1.09bc	1.08bc	1.07a
3,6-DPA.....	1.40a	.95b-e	.74e-g	.70fg	.95b
Glyphosate.....	1.12b	.96b-e	.79d-g	.70fg	.89b
Picloram.....	1.01b-d	.88c-f	.80d-g	.86c-f	.89b
2,4,5-T.....	1.14b	1.00b-d	.86c-f	.58g	.89b
Triclopyr.....	1.02b-d	.80d-g	.66fg	.62g	.78c
Mean.....	1.12a	.94b	.82c	.76c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 53.—Aspartic acid concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Aspartic acid concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.70cd	1.72cd	1.64d	1.74cd	1.70c
3,6-DPA.....	1.89bc	2.13a	2.03ab	1.62d	1.92a
Glyphosate.....	1.88bc	1.73cd	1.56de	1.40f	1.64cd
Picloram.....	1.74cd	1.88bc	1.86bc	1.70cd	1.80b
2,4,5-T.....	1.98b	1.90bc	1.64d	1.36f	1.72bc
Triclopyr.....	1.85bc	1.70cd	1.41ef	1.30f	1.56d
Mean.....	1.84a	1.84a	1.69b	1.52c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 54.—Glutamic acid concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Glutamic acid concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.87a-e	1.88a-d	1.81b-f	1.88a-d	1.86a
3,6-DPA.....	2.01a-c	1.96a-d	1.64e-g	1.48g-i	1.77bc
Glyphosate.....	2.02ab	1.80b-f	1.58f-i	1.38h-j	1.69c
Picloram.....	1.89a-d	1.78c-f	1.74d-f	1.81b-f	1.80ab
2,4,5-T.....	2.06a	1.88a-d	1.62fg	1.18j	1.69c
Triclopyr.....	1.92a-d	1.60f-h	1.35ij	1.21j	1.52d
Mean.....	1.96a	1.82b	1.62c	1.49d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 55.—Glycine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Glycine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.96a-d	0.96a-d	0.93b-e	0.97a-d	0.96a
3,6-DPA.....	.99a-c	.88d-h	.72j-m	.70k-n	.82b
Glyphosate.....	1.02ab	.91c-g	.78h-k	.72j-m	.86b
Picloram.....	.92b-f	.81g-j	.75i-l	.84e-i	.83b
2,4,5-T.....	1.04a	.94a-e	.82f-j	.60n	.85b
Triclopyr.....	.93b-e	.78h-k	.66l-n	.62mn	.75c
Mean.....	.98a	.88b	.78c	.74c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 56.—Histidine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Histidine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.42a-d	0.42a-d	0.43a-c	0.42a-d	0.42a
3,6-DPA.....	.44a-c	.42a-d	.34fg	.26h	.37b
Glyphosate.....	.45ab	.40b-e	.34fg	.28h	.37b
Picloram.....	.42a-d	.39c-f	.34fg	.30gh	.36b
2,4,5-T.....	.46a	.42a-d	.37d-f	.28h	.38b
Triclopyr.....	.42a-d	.36ef	.30gh	.27h	.34c
Mean.....	.44a	.40b	.35c	.30d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 57.--Isoleucine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Isoleucine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.80a-c	0.80a-c	0.77b-d	0.80a-c	0.79a
3,6-DPA.....	.84ab	.77b-d	.60f-i	.58g-i	.70b
Glyphosate.....	.85ab	.76b-d	.65e-h	.50i	.69b
Picloram.....	.78a-c	.70c-f	.64e-h	.72c-e	.71b
2,4,5-T.....	.88a	.80a-c	.70c-f	.50i	.72b
Triclopyr.....	.80a-c	.67d-g	.56hi	.52i	.64c
Mean.....	.82a	.75b	.65c	.60d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 58.--Leucine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Leucine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.56a-c	1.58ab	1.52a-d	1.58ab	1.56a
3,6-DPA.....	1.62ab	1.38a-f	1.06g-i	1.00g-i	1.26ab
Glyphosate.....	1.66a	1.42a-f	1.17e-i	.54j	1.20ab
Picloram.....	1.50a-e	1.28b-g	1.14f-i	1.26c-h	1.29ab
2,4,5-T.....	1.70a	1.50a-e	1.29b-g	.85i	1.33a
Triclopyr.....	1.52a-d	1.21d-h	1.00g-i	.92hi	1.16b
Mean.....	1.59a	1.40b	1.20c	1.02d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 59.--Lysine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Lysine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.21a-c	1.22a-c	1.24a-c	1.24a-c	1.23a
3,6-DPA.....	1.26ab	1.12c-f	.90h-j	.86i-k	1.04b
Glyphosate.....	1.28a	1.14b-e	.96g-i	.87h-k	1.06b
Picloram.....	1.18a-d	1.04e-g	.96g-i	1.06d-g	1.06b
2,4,5-T.....	1.31a	1.18a-d	1.04e-g	.74k	1.07b
Triclopyr.....	1.20a-c	1.00f-h	.85i-k	.78jk	.96c
Mean.....	1.24a	1.12b	.99c	.92d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 60.--Methionine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Methionine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.32a-c	0.32a-c	0.31a-c	0.32a-c	0.32a
3,6-DPA.....	.32a-c	.28c-f	.21h-j	.18jk	.25bc
Glyphosate.....	.35a	.29c-e	.24f-i	.20i-k	.27b
Picloram.....	.31a-c	.26d-g	.22g-j	.24f-i	.26bc
2,4,5-T.....	.34ab	.30b-d	.26d-g	.16k	.27b
Triclopyr.....	.32a-c	.25e-h	.20i-k	.18jk	.24c
Mean.....	.33a	.28b	.24c	.21d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 61.—Phenylalanine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Phenylalanine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.05a-c	1.04a-d	1.02a-d	1.06a-c	1.04a
3,6-DPA.....	1.07a-c	.93d-f	.73h-j	.72h-j	.86b
Glyphosate.....	1.09ab	.96c-e	.78g-i	.70i-k	.88b
Picloram.....	.99b-d	.86e-g	.78g-i	.85e-g	.87b
2,4,5-T.....	1.13a	1.02a-d	.88e-g	.60k	.91b
Triclopyr.....	1.00b-d	.82f-h	.70i-k	.65jk	.80c
Mean.....	1.06a	.94b	.82c	.76d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 62.—Proline concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Proline concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.99a-e	1.00a-d	0.97b-e	0.98b-e	0.98ab
3,6-DPA.....	1.04a-c	1.02a-c	.97b-e	.84ef	.97ab
Glyphosate.....	1.08ab	1.04a-c	1.00a-d	.86d-f	.99ab
Picloram.....	.98b-e	.99a-e	.98b-e	.89c-f	.96ab
2,4,5-T.....	1.14a	1.10ab	1.02a-c	.84ef	1.02a
Triclopyr.....	1.06ab	1.04a-c	.86d-f	.77f	.93b
Mean.....	1.05a	1.03a	.97b	.86c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 63.--Serine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Serine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.85a-e	0.86a-d	0.85a-e	0.88a-c	0.86a
3,6-DPA.....	.87a-d	.83b-e	.60f-h	.67gh	.76c
Glyphosate.....	.92ab	.85a-e	.74e-g	.74e-g	.81b
Picloram.....	.82b-e	.80c-f	.76d-g	.84b-e	.80b
2,4,5-T.....	.96a	.88a-c	.80c-f	.60h	.81b
Triclopyr.....	.86a-d	.76d-g	.66gh	.60h	.72c
Mean.....	.88a	.83b	.74c	.72c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 64.--Threonine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Threonine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.84a-c	0.84a-c	0.80b-e	0.83a-c	0.83a
3,6-DPA.....	.87ab	.74c-f	.59hi	.57hi	.69c
Glyphosate.....	.92a	.80b-e	.66f-h	.60g-i	.74b
Picloram.....	.82a-d	.70e-g	.64f-h	.70e-g	.72bc
2,4,5-T.....	.92a	.82a-d	.72d-f	.50i	.74b
Triclopyr.....	.82a-d	.66f-h	.56hi	.51i	.63d
Mean.....	.86a	.76b	.66c	.62d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 65.--Tyrosine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Tyrosine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	0.80ab	0.78ab	0.76a-c	0.79ab	0.78a
3,6-DPA.....	.80ab	.66c-f	.52h-j	.50ij	.62cd
Glyphosate.....	.82a	.71b-e	.59f-i	.54g-j	.67b
Picloram.....	.74a-d	.63e-g	.56f-j	.62e-h	.64bc
2,4,5-T.....	.84a	.74a-d	.65d-f	.46j	.68b
Triclopyr.....	.74a-d	.60f-i	.52h-j	.48j	.58d
Mean.....	.79a	.69b	.60c	.56c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 66.--Valine concentrations in leaves of honey mesquite sprayed with five herbicides (at 1.12 kg ae per hectare) on May 30, 1978, and sampled on four dates

Treatment	Valine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 1 (2)	June 3 (4)	June 5 (6)	June 9 (10)	
Untreated.....	1.06a-c	1.06a-c	1.03a-e	1.06a-c	1.05a
3,6-DPA.....	1.10ab	1.00b-f	.78h-j	.74ij	.90b
Glyphosate.....	1.14a	1.00b-f	.86g-i	.66j	.92b
Picloram.....	1.03a-e	.94c-g	.84g-i	.92d-g	.93b
2,4,5-T.....	1.16a	1.05a-d	.91e-h	.66j	.94b
Triclopyr.....	1.06a-c	.88f-h	.74ij	.68j	.84c
Mean.....	1.09a	.99b	.86c	.79d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 67.--Alanine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Alanine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.65b	0.60b-e	0.63bc	0.58b-f	0.62a
2,4-D.....	.64bc	.50fg	.30h	.25h	.42b
3,6-DPA.....	.79a	.66b	.52e-g	.52e-g	.62a
Glyphosate.....	.62b-d	.64bc	.58b-f	.55c-f	.60a
Picloram.....	.59b-e	.44g	.26h	.30h	.40b
Triclopyr.....	.54d-f	.45g	.32h	.27h	.40b
Mean.....	.64a	.55b	.43c	.41c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 68.--Ammonia concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Ammonia concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.19bc	0.18b-d	0.18b-d	0.17b-e	0.18b
2,4-D.....	.18b-d	.17b-e	.14ef	.14ef	.16c
3,6-DPA.....	.24a	.20b	.16c-f	.16c-f	.19a
Glyphosate.....	.18b-d	.18b-d	.18b-d	.16c-f	.18b
Picloram.....	.18b-d	.16c-f	.13f	.15d-f	.15c
Triclopyr.....	.18b-d	.17b-e	.16c-f	.14ef	.16c
Mean.....	.19a	.18b	.16c	.16c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 69.--Arginine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Arginine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.66b	0.60b-d	0.64bc	0.58b-d	0.62a
2,4-D.....	.63bc	.48de	.28g	.22g	.40b
3,6-DPA.....	.78a	.66b	.50de	.50de	.61a
Glyphosate.....	.62bc	.64bc	.56b-d	.54b-e	.59a
Picloram.....	.58b-d	.33fg	.22g	.24g	.34c
Triclopyr.....	.53c-e	.43ef	.28g	.23g	.37bc
Mean.....	.63a	.52b	.41c	.39c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 70.--Aspartic acid concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Aspartic acid concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	1.04bc	0.97b-e	1.02b-d	0.93b-g	0.99a
2,4-D.....	1.02b-d	.84e-h	.54ij	.51ij	.73b
3,6-DPA.....	1.30a	1.08b	.82f-h	.83e-h	1.01a
Glyphosate.....	1.00b-d	1.00b-d	.97b-e	.89c-h	.96a
Picloram.....	.95b-f	.77h	.48j	.56ij	.69b
Triclopyr.....	.88d-h	.79gh	.62i	.55ij	.71b
Mean.....	1.03a	.91b	.74c	.71c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 71.--Glutamic acid concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Glutamic acid concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	1.20bc	1.13b-e	1.18b-d	1.06c-g	1.14a
2,4-D.....	1.18b-d	.98e-i	.58jk	.47k	.80b
3,6-DPA.....	1.52a	1.26b	.94g-i	.96f-i	1.17a
Glyphosate.....	1.14b-e	1.18b-d	1.08c-g	1.02e-i	1.10a
Picloram.....	1.11b-f	.86i	.49jk	.53jk	.75b
Triclopyr.....	1.04d-h	.89hi	.64j	.51jk	.77b
Mean.....	1.20a	1.05b	.82c	.76d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 72.--Glycine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Glycine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.60bc	0.56b-d	0.58bc	0.56b-d	0.58a
2,4-D.....	.60bc	.48de	.30f	.26f	.41b
3,6-DPA.....	.75a	.62b	.48de	.48de	.58a
Glyphosate.....	.58bc	.60bc	.54b-d	.52cd	.56a
Picloram.....	.56b-d	.43e	.25f	.28f	.38b
Triclopyr.....	.51c-e	.43e	.31f	.26f	.38b
Mean.....	.60a	.52b	.41c	.39c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 73.—Histidine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Histidine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.28bc	0.24c-f	0.26b-d	0.24c-f	0.26b
2,4-D.....	.27bc	.22e-g	.12i	.10i	.18c
3,6-DPA.....	.40a	.29b	.21f-h	.20gh	.28a
Glyphosate.....	.26b-d	.26b-d	.24c-f	.23d-g	.25b
Picloram.....	.25c-e	.18h	.10i	.10i	.16d
Triclopyr.....	.22e-g	.18h	.13i	.10i	.16d
Mean.....	.28a	.23b	.18c	.16d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 74.—Isoleucine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Isoleucine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.50b	0.48bc	0.50b	0.46b-d	0.48a
2,4-D.....	.50b	.40de	.24f	.20f	.34b
3,6-DPA.....	.62a	.51b	.40de	.40de	.48a
Glyphosate.....	.48bc	.50bc	.46b-d	.43cd	.47a
Picloram.....	.47b-d	.36e	.20f	.23f	.32b
Triclopyr.....	.43cd	.36e	.26f	.22f	.32b
Mean.....	.50a	.44b	.35c	.32d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 75.--Leucine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Leucine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.98b	0.92bc	0.98b	0.88b-e	0.94a
2,4-D.....	.97b	.76ef	.44g	.34g	.63b
3,6-DPA.....	1.18a	.99b	.78d-f	.78d-f	.93a
Glyphosate.....	.94bc	.96b	.86b-e	.82c-e	.90a
Picloram.....	.90b-d	.68f	.36g	.40g	.59b
Triclopyr.....	.82c-e	.68f	.46g	.37g	.58b
Mean.....	.97a	.83b	.65c	.60d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 76.--Lysine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Lysine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.75bc	0.69b-d	0.64c-e	0.68b-d	0.71a
2,4-D.....	.74bc	.62de	.38f	.30f	.51b
3,6-DPA.....	.94a	.76b	.60d-e	.59d-e	.72a
Glyphosate.....	.72bc	.74bc	.68b-d	.64c-e	.70a
Picloram.....	.68b-d	.54e	.32f	.33f	.47b
Triclopyr.....	.64c-e	.55e	.40f	.32f	.48b
Mean.....	.75a	.65b	.52c	.48d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 77.--Methionine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Methionine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.21bc	0.20b-d	0.22ab	0.18c-e	0.20a
2,4-D.....	.20b-d	.14fg	.08h	.06h	.12b
3,6-DPA.....	.24a	.20b-d	.16e-g	.16e-g	.19a
Glyphosate.....	.20b-d	.20b-d	.18c-e	.18c-e	.19a
Picloram.....	.19b-e	.13g	.06h	.06h	.11b
Triclopyr.....	.17d-f	.14fg	.08h	.06h	.12b
Mean.....	.20a	.17b	.13c	.12d	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 78.--Phenylalanine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Phenylalanine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.62b	0.58b-d	0.60bc	0.55b-e	0.59a
2,4-D.....	.61b	.48ef	.28g	.23g	.40b
3,6-DPA.....	.74a	.62b	.49ef	.50d-f	.58a
Glyphosate.....	.59bc	.60bc	.54b-e	.52d-e	.56a
Picloram.....	.56b-e	.42f	.24g	.26g	.37b
Triclopyr.....	.52c-e	.42f	.30g	.25g	.37b
Mean.....	.61a	.52b	.41c	.38c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 79.--Proline concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Proline concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.58b	0.52b-e	0.54b-d	0.50b-f	0.53a
2,4-D.....	.56bc	.46d-f	.30g	.26g	.40b
3,6-DPA.....	.68a	.57b	.43f	.44ef	.53a
Glyphosate.....	.54b-d	.52b-e	.53b-d	.48c-f	.52a
Picloram.....	.50b-f	.42f	.26g	.28g	.36b
Triclopyr.....	.46d-f	.42f	.30g	.28g	.36b
Mean.....	.55a	.49b	.39c	.37c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 80.--Serine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Serine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.49b	0.46bc	0.48b	0.44b-d	0.47a
2,4-D.....	.49b	.42b-e	.27f	.24f	.35b
3,6-DPA.....	.59a	.49b	.38de	.40c-e	.46a
Glyphosate.....	.48b	.48b	.44b-d	.42b-e	.46a
Picloram.....	.45b-d	.36e	.24f	.26f	.33b
Triclopyr.....	.44b-d	.38de	.30f	.26f	.34b
Mean.....	.49a	.43b	.35c	.34c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 81.—Threonine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Threonine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.54b	0.50b-d	0.52bc	0.47c-f	0.50a
2,4-D.....	.52bc	.41fg	.25h	.22h	.35b
3,6-DPA.....	.65a	.54b	.42e-g	.43e-g	.51a
Glyphosate.....	.50b-d	.51b-d	.46c-f	.44d-f	.48a
Picloram.....	.48b-e	.37g	.22h	.26h	.33b
Triclopyr.....	.44d-f	.36g	.28h	.24h	.33b
Mean.....	.52a	.45b	.36c	.34c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 82.—Tyrosine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Tyrosine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.48bc	0.44b-e	0.48bc	0.44b-e	0.46a
2,4-D.....	.48bc	.37e-g	.21h	.18h	.31b
3,6-DPA.....	.60a	.50b	.38e-g	.38e-g	.46a
Glyphosate.....	.46b-d	.48bc	.43b-f	.41c-f	.44a
Picloram.....	.44b-e	.36fg	.18h	.21h	.30b
Triclopyr.....	.40d-g	.32g	.24h	.20h	.29b
Mean.....	.48a	.41b	.32c	.30c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

Table 83.—Valine concentrations in leaves of Macartney rose sprayed with five herbicides (at 2.24 kg ae per hectare) on June 12, 1978, and sampled on four dates

Treatment	Valine concentration (g/100 g moisture-free tissue)[1]				
	Sampling date (days after spraying)				Mean
	June 14 (2)	June 16 (4)	June 20 (8)	June 30 (18)	
Untreated.....	0.64bc	0.60b-e	0.62b-d	0.58c-f	0.61a
2,4-D.....	.64bc	.51fg	.32h	.26h	.43b
3,6-DPA.....	.80a	.66b	.52e-g	.52e-g	.63a
Glyphosate.....	.62b-d	.64bc	.58c-f	.55d-g	.60a
Picloram.....	.60b-e	.46g	.27h	.30h	.41b
Triclopyr.....	.54d-g	.46g	.33h	.28h	.40b
Mean.....	.64a	.56b	.44c	.41c	....

[1]Values followed by a common letter among the date-by-treatment interactions or in each group of means are not significantly different at the 5% level by Duncan's new multiple-range test.

APPENDIX.—CHEMICAL NAMES OF HERBICIDES STUDIED

Atrazine . . . . . 2-Chloro-4-(ethylamino)-6-(isopropylamino)-*s*-triazine.
Bromacil . . . . . 5-Bromo-3-*sec*-butyl-6-methyluracil.
2,4-D . . . . . (2,4-Dichlorophenoxy)acetic acid.
Dalapon . . . . . 2,2-Dichloropropionic acid.
Dicamba . . . . . 3,6-Dichloro-*o*-anisic acid.
3,6-DPA . . . . . 3,6-Dichloropicolinic acid.
Glyphosate . . . . . *N*-(Phosphonomethyl)glycine.
Hexazinone . . . . . 3-Cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1*H*,3*H*)-dione.
Picloram . . . . . 4-Amino-3,5,6-trichloropicolinic acid.
2,4,5-T . . . . . (2,4,5-Trichlorophenoxy)acetic acid.
Tebuthiuron . . . . . *N*-[5-(1,1-Dimethylethyl)-1,3,4-thiadiazol-2-yl]-*N*,*N*'-dimethylurea.
Triclopyr . . . . . [(3,5,6-Trichloro-2-pyridinyl)oxy]acetic acid.

☆U.S. GOVERNMENT PRINTING OFFICE:1983 -669 -038/ 10 REGION NO. 4

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
SOUTHERN REGION
P. O. BOX 53326
NEW ORLEANS, LOUISIANA 70153

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF
AGRICULTURE
AGR 101

FIRST CLASS